Families and Communities Empowering Student Success

Evaluation Report

August 2020

CRADLE TO CAREER POLICY INSTITUTE

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Executive Summary

The National Science Foundation (NSF) awarded a grant to the Explora Museum to serve as the host agency for the Families and Communities Ensuring Student Success (FACESS) project, designed to broaden the math achievement of students, especially those of color and lower SES.

The project, envisioned as a pilot effort, would focus on the professional development in mathematics pedagogy and skills of teachers and expanded understanding of parents of mathematics and its applications, which would then result in the formation of better attitudes and classroom performance in mathematics of elementary school children.

The project built on the ideas that Jo Boaler of Stanford University related to the mathematical mindset and the parallel and foundational work of Carol Dweck, also of Stanford, who has extensively researched what she terms a growth mindset. Their respective texts, *Mathematical Mindsets and Mindset*, provided much of the philosophical and pedagogical orientation of the professional development and outreach of the FACESS project.

The Explora Museum served as the overall FACESS project manager.

The UNM Cradle to Career Policy Institute served as the evaluator of the project.

Planned to commence with recruitment and development of workshops in fall 2017 with full implementation in spring 2018, various delays postponed workshop implementation to fall 2018. Formal recruitment of participants did not occur until January 2019 after the university and district granted research approval.

The application submitted to the NSF originally scheduled the project to end in August 2019. Due to the delays in implementation, Explora staff requested and received a no-cost extension of the study to August 2020.

A large metropolitan district in the Southwest served as the host of the two schools that originally participated in the project. A third school agreed to participate for the second planned year of the evaluation. The report results show these schools as A, B, and C, respectively to protect anonymity of all participants.

The resignation of the original principal investigator at CCPI contributed to the delay in the processing and submission of research approval applications submitted to the UNM Office of Institutional Review Board and the research review board of the host district. The two boards completed their approvals in December 2018.

The original evaluation design included a base and post component for teachers, parents, and students. Delays in the research approval process necessitated suspension of the original design during the first year for teachers and parents to a retrospective survey that collected data on workshop participation upon completion of those activities. The study retained the base and post survey design for the children although the timeframe of survey administration collapsed to the beginning and end of spring semester 2019, not the beginning and end of the school year as originally intended.

Evaluation activities at the schools began in January 2019. These included outreach and orientation meetings with staff at the two participant schools, distribution of waiver of consent documents, and provision of student survey packets to the educators. The teacher packets included parental information and waiver of consent documentation in both English and Spanish that provided an overview of the study and explained participation was voluntary.

Teachers sent this documentation home with the children. In response, two parents conducted the evaluation PI to request their child not participate. The PI contacted the principals at the schools to ensure teachers did not include the identified children in the survey activity.

Due to nominal participation of teachers and parents at one of the participating schools, the coordination team decided to invite a third school in the host district to participate. The principal agreed to have staff participate. The evaluation PI submitted amendment modifications to UNM OIRB and the host district review board, both of which approved the study extension and expansion of an additional school. Second year workshops commenced and survey administrations occurred in September 2019.

The COVID19 pandemic led to a statewide school closure order. This order resulted in the suspension of all workshop and other professional development activities and related data collection.

Findings

Teachers

At the end of the first year of their workshop participation, many teachers apparently modified their thinking about math pedagogy and the abilities of their students related to the discipline. The results are highly suggestive that many have embraced a "growth mindset" related to their own and their students' development in math.

Sixteen first year teachers who participated in the workshops completed the survey. Select first year findings on educators reveal the following main points, in that the participating teachers are:

- Disinclined to show a student how to solve a math problem while simultaneously being more willing to engage the student on her thinking process used to approach math problems.
- More willing to describe patterns and relationships as a means of approaching math problems.
- More willing to allow students make mistakes and engage in group work to approach and solve math problems.
- Disinclined to use ability groups to "corral" students of certain skill levels.
- Generally at ease for leading class discussions on math.
- Encouraging of students developing multiple strategies for solving math problems.
- Disinclined to promote speed and getting the right answer and more inclined to allow a student to develop a deeper understanding of the how and why of solving challenging math problems.

- More willing to encourage students to share ideas about math with them and other students.
- Less likely to think some people have a natural talent for math and more likely to think anyone can become better skilled in the discipline given the proper guidance and support.
- Disinclined to rely solely on math textbooks and related worksheets for students to practice their math skills.
- Mixed in their willingness to reach out to parents to determine the math experiences of students outside of schools.
- Not very likely to have families of students ask for help with math homework.
- Generally willing to think they are good at math.

For the **second year findings**, which included a new set of teachers, the results parallel to a degree those from the first year, with some significant exceptions. Twenty-nine second year teachers completed the base survey at the beginning of the second year. As noted previously, a post administration after completion of the workshops did not occur due to the COVID19 pandemic. Examples of the exceptions include a fair amount of teachers who are more neutral, or perhaps unsure:

- About their willingness to show students how to solve a math problem.
- Toward the notion that some people have a natural talent for math and others do not.
- About using textbook-related worksheets for students to practice math skills.
- That it is a best practice to show a struggling student how to solve a challenging math problem.
- About reaching out to families to get information about their students' experiences with math outside of school.
- About the willingness of students' families to reach out to them for help on homework.
- About their willingness to have students replicate a math problem solution they showed them.

Parents

Parents who participated in the workshops and provided their impressions on the surveys tend to show positive results from their experience in the workshops and use of related resources, such as completing the online you.cubed.org materials and to a lesser extent, those from the 12 Months of Math website. Twenty parents who participated in the workshops completed the surveys. What follows are some select main findings from the surveys administered after completion of the year one workshops, in that we find many parents who:

- Show an interest in the math their child is doing at school.
- Feel less lost in relation to helping their child do math.
- Are empowered in their relationship to math.
- Understand that math knowledge is important for success in life.

- Encourage their child to persist in working through challenging math problems.
- Are less nervous about helping their child with math and more empathetic about their child's math-related frustrations.
- Remain a bit nervous helping their child with some math problems.
- More likely to hide their negative feelings toward math in front of their child.
- Are secure in their belief they are good at math.
- Are asking their child about their day with math more often.
- Are more encouraging of their child to learn new ways about solving math problems.

Students

School Demographics

School A enrolls students in kindergarten through grade 6. Approximately 45% of the students are underrepresented minorities, 10% are in special education, 9% are English learners, and 45% are eligible for Free or Reduced Lunch programs.

School B enrolls students in preschool through grade 5. Approximately 92% of the students are underrepresented minorities, 16% are in special education, 55% are English learners, and 99% are eligible for Free or Reduced Lunch programs.

School C enrolls students in kindergarten through grade 5. Approximately 86% of students are underrepresented minorities, 26% are in special education, 34% are English learners, 100% are eligible for Free and Reduced lunch programs. School C only participated in the second year of the study.

While students did not participate in the workshops their teachers or parents did, they would have benefitted from those adults who did. Through the workshops, the facilitators exposed teachers to recent research related to math instruction and pedagogical strategies and shown techniques to help students approach and understand math more deeply. The following provides some of the key results from year one that provides a base and post perspective from the survey and the base results from year two. To avoid a plethora of graphs, the student results were aggregated into grade groups: 1 & 2, and 3 to 5, with the percentage difference of result means between the post and base shown in a separate graph. The graphs display discrete aggregated findings for the two grade groups by schools A and B. The results exclude students from kindergarten due to the excessive amount of teacher assistance many of them needed and their unfamiliarity with survey scales. This assistance resulted in highly skewed findings, which rendered them unusable. The second year includes base results from the third school, denoted by C, along with schools A and B. The analysis used the statistical program R and Tableau for the data display.

Various select findings show students from year one who:

- At School A in grades 1 & 2, those who enjoyed thinking about math with their teachers declined by 5.3%, while in grades 3 to 5 at the same school and both grade groups at School B this mean percentage increased by 3.5%, 4.1% and 3.3%, respectively.

- When prompted about whether they changed their thinking once they heard their classmates ideas about math, the difference of results means for both grade groups at School A declined by -7.3 and -1.6%, respectively; while at Schools B, the decline for grade group 1-2 was -16.6% but increased by 14.6% for 14.6%.
- A sense of personal efficacy is important in dealing with the daily vagaries of life. Developing this sense is particularly important with math. When asked whether they thought themselves good at math, while there was a decline in the difference of result means for both schools in grades 1 & 2 of -0.4 and -20.8%, for A & B, respectively; grades 3 to 5 for both schools showed increases of 3.4% and 6.3%, respectively.
- Having a family that supports you in succeeding at school can do much to ensure that success. This prompt sought to determine whether year one students agreed that, "It is important to my family that I do well in math." At both schools, the difference of result means for grades 1 & 2, the level of agreement declined -1.9% and -3.9% for A and B, respectively; and increased for grades 3 to 5 by 2.7% and 2.8%, respectively.
- One query posed to year one students was this, "Math is challenging for me." The percentages of students who strongly disagreed with the statement suggest they felt capable and empowered when dealing with math. As reflected in the difference of results means, grades 1 & 2 showed a decline of -14.7% at School A and increased by 17.2% in School B. In grades 3 to 5, the difference increased by 4.2% at School A and decreased by -5.4% at B.
- The attitude that immediate family members have towards math can strongly influence a child's perspective positively or negatively. Asked to what level they agreed with the statement, "My family likes math," the difference of results means graph shows student agreement with the statement at School A declined by -6.7% in grades 1 & 2, but increased by 2.2% in grades 3 to 5. The means difference at School B declined by -9.6% in grades 1 & 2 and -3.0% in grades 3 to 5.
- Peer group influence can be a major factor in a young child's life. Having a sense of support from friends about doing well in school can help a child decide to stay in school, persist through graduation, and go onto college or a fulfilling career. Asked to what level they agreed with the prompt, "My friends want to do well in math," the difference of results means at School A declined by -6.0% in grades 1 & 2 but increased by 3.8% in grades 3 to 5. At School B, the difference increased at both levels by 4.1% in 1 & 2 and 13.2% in 3 to 5.
- Queried on whether they thought their classmates were interested in their thinking on math, the difference in results means at School A for grades 1 & 2 and grades 3 to 5 showed net increases of 7.0% and 6.4%, respectively. At School B, there was a net decrease of -14.2% for grades 1 & 2, and a net increase of 10.2% for grades 3 to 5.
- Another prompt, "I don't like to share my ideas about math," produced the following difference of result means shows decreases of -10.0% for grades 1 & 2 and -9.1% for grades 3 to 5 at School A. For School B, the declines came in at -22.5% and -15.3% for the two grade groups. This is actually the direction one wants the trend to go. Not being willing to share ideas can be an impediment to a student's willingness to engage in group projects or take advantage of the "cross pollination" that comes from the exchange of ideas.

- The following query, "My teacher wants me to do well in math," focused on teacher support for math performance. Perceiving your teacher cares or doesn't can exert a major influence on a student's academic performance. The difference of results means showed a decline of -21.8% for grades 1 & 2 and an increase of 3.4% for grades 3 to 5 at School A. For School B, the result means difference showed increases of 2.1% and 1.7% for the two grade group levels.

Year 2 Results

- For the prompt of do they like thinking about math with their teachers between 65.3% and 78.5% of students in grade group 1-2 strongly agreed while the percentages declined across all three schools for grades 3 to 5. Percentages who strongly agreed ranged from 37.0% at School C and 37.9% at School B to 53.8% at School A.
- Base results for year 2 for the prompt of whether they changed their thinking once they heard their classmates thoughts about math show a range in the numbers for grades 1 & 2 who strongly agreed they did so from of 38.1% at School C to 73.3% at School A. For grade group 3 to 5, the number who strongly agreed with the prompts were significantly more modest ranging from 12.7% at School C to 20.4% at School A.
- When asked to what level they agreed with the statement "I am good at solving math problems," large percentages of year 2 students in grades 1 & 2 in all three schools (A:67.4%;B:61.4%;C73.5%) selected strongly agreed. These percentages dropped off in grade 3 to 5 across all three schools (A:28.0%;B:37.9%; C:43.2%).
- High percentages of students strongly agreed with the prompt, "It is important to my family that I do well in math." The percentages range from roughly 70% at one school to nearly 90% at another. For grades 1 & 2, the percentage of students at each school were A:88.6%; B:79.0%, and C:76.6%. In grades 3 to 5, these percentages are A:74.4%; B:75.1%; and C:71.2%.
- Year two students who strongly disagreed with the statement, "Math is challenging for me," indicate they felt capable and empowered when dealing with math. However, we only see a group in grades 1 & 2 in School C at 48.9%, while the students in grades 3 to 5 who chose that option came in at 20.7%. For School A, the split between the grade group levels for those who chose strongly disagreed comes in at 38.3% for grades 1 & 2 and 15.8% for grades 3 to 5. At School B, the percentages tick up somewhat in that 41.7% of grade 1 & 2 students chose strongly disagreed and 25.4% of those in grades 3 to 5 selected that option.
- Students responses in the year two base survey illustrate a mixed perspective among the students from the three schools concerning to what degree they agreed with the prompt, "My family likes math." For those who strongly agreed, strong majorities of students in grades 1 & 2 appeared in School A (72.3%) and School C (67.8%) but only showed 47.5% at School B. None of the students in grades 3 to 5 reached a majority for those who strongly agreed with the statement as these figures reflect (A:34.8%; B:29.3%; and C:34.7%).

- Base results for year two show that majorities of all children want their friends to do well in math. For those students in grades 1 & 2, School A showed 87.0%, School B came in at 73.3% and School C with 71.4% strongly agreed. In grades 3 to 5, 57.7% of School A , 62.9% of School B, and 53.4% of School C students selected that option.
- Queried for a base reading on whether students thought their classmates were interested in their thinking about math, the results showed a broad distribution for those who strongly agreed. For instance, in grades 1 & 2 at School A the percentage is 68.1, for School B the figure is 42.5%, and 56.0% at School C. At grade levels 3 to 5, the percentages who made that selection dropped to 19.7% at School A, 26.9% at B, and 18.5% at C.
- In the year two base survey students who strongly agreed with the statement, "I don't like to share my ideas about math," appeared in a majority only in grades 1 & 2 at School A. At School B, this figure was less than a quarter at 23.5% and at nearly one-half at 47.2% for School C. For students at grade levels 3 to 5, the percentages of students who made this choice dropped into the twenties at each school as shown here—A:23.6%; B:26.6%; and C:20.3%.
- Year two student base scores for the query, "My teachers wants me to do well in math," significant majorities at both grade group levels and across all three schools chose strongly agreed. The percentage counts for grades 1 & 2 came in at 93.5%, 90.9% and 87.6% for schools A, B, and C, respectively. For grades 3 to 5, the counts were A:87.9%, B:88.7%, and C:85.5%.

PARCC Results

For the PARCC state assessment, results show a significant difference in math performance between the students at School A and those at School B. These masked names for the schools that participated in the first year evaluation activities. The statistical tests run and the similar size of each school population support the conclusion that the findings are not simply random chance.

Summary Statement

To determine whether such a shift in mindset toward mathematics could be achieved at a pilot level in two elementary schools, the FACESS project had four primary aims/objectives:

1. improve students' attitudes, practices, and achievement in math;
2. improve parents' attitudes, practices, and confidence in math and increase their utilization of family math resources;
3. improve data-sharing among partners related to math participation and achievement, and
4. create pathways within the NM STEM Ecosystem for family math learning.

In response to the first objective, based on survey results the FACESS project appears to have mixed findings in relation to improvements in student attitudes, practices and achievement in math. For example:

- For year one students in grades 1 & 2 in both schools, the percentages who agreed they like thinking about math with their teacher remained above 50% by year's end even though the percentages declined from base figures. On the other hand, the percentage in grades 3 to 5 dropped below 50% in one school, and although the percentage declined in the other, it remained above 50%. The base results for **year two** students in grades 1 & 2 across all three schools who strongly agreed they liked thinking about math with their teacher show large percentages (65%+). However, the percentage of students from grades 3 to 5 in two of the three schools declined to below 40% while staying above 50% in the other. Such results suggest that students in the lower grades begin with high expectations about engaging in mathematics but this enthusiasm declines as they move up in grades.
- The perception of students in grades 1 & 2 who agreed that their teachers were interested in hearing about their ideas when they talked about math declined between the base and post during the first year but for the students in grades 3 to 5, the percentages who agreed increased between the two points. For the second year base results, large percentages of children in grades 1 & 2 in all three schools thought their teachers were interested; however, in grades 3 to 5 across all schools the percentages of students who agreed with the statement dropped substantially. These results suggest that if teachers sincerely engage their students on math they are likely to help keep their interests up and that the upper level elementary teachers appear to be doing a better job of this currently than the lower grade level teachers at all three schools.
- Most students regardless of grade level or school strongly agree their families want them to do well in math; and report they have somebody at home to help with math homework. The same patterns appears for the base score collected for year two. This finding is really positive in that majorities of students think their families support them with their math studies. Having that type of familial support can be critical as a student moves through their school career.
- In year one, while large percentages of students in grades 1 and 2 believe they are good at math, these percentages shift downward as the students move into grades 3 to 5. This same general pattern of belief in high math ability at the lower grades and diminished ability in the upper elementary holds for the year two base results. These results also suggest that students start out with a high level of perceived efficacy in math but hit obstacles that slow many of them down as they move into the higher grades. The question this poses is whether the training teachers received in the Mathematical Mindsets workshops will translate into continued perceived student efficacy in math as they advance in grade levels?

In response to objective two, the results from the surveys suggest that the twenty parents who participated in the workshops appear to have improved their attitudes, practices and confidence related to math. For example, of the twenty parents who answered the survey:

- Nineteen (95%) of the parents understand that it is important for them to show interest in their child's math-related schoolwork.
- Fourteen (70%) no longer feel lost when they help their child with math.
- Seventeen (85%) understand they know enough math.

- Twenty (100%) understand that understanding math is important for success in life.
- Sixteen (75%) understand their child's frustration when it comes to math.
- Eleven (55%) no longer get nervous doing simple math problems.
- Seven (35%) agreed and another 6 (30%) were neutral in regards to the belief that some people have a natural talent for math and others do not. Their experience in the workshops should have led them to the belief that all people have the capacity to learn in the discipline.
- Nineteen (95%) encourage their child to talk about solving math problems.
- Nineteen (95%) encourage their child to learn new ways to think about math.

The sub-point in this objective, increasing utilization of family-based math resources, showed more engagement with the you.cubed.org related resources than the 12 Months of Math resources. The reasons for this remain obscure because the survey did not ask a question as to the why, or why not, parents accessed these resources. For example:

- When asked how many you.cubed.org lessons they completed, thirteen (65%) indicated the full amount six, another one each completed five, four, or two. And another two each indicated they had completed either two or none. The expectation put forth for participation was for the parents to complete the workshops and one-third of them did not.
- Asked whether they had seen 12 Months of Math only two (11%) parents of the eighteen that answered indicated they had often done so and twelve (67%) indicated seldom or never.
- When answering the follow-up question of whether they had participated in 12 Months of Math activities, of the seventeen that answered, six (35%) often or very often did, while eleven (65%) seldom or never did.

For objective three, there is no evidence that the partners have developed any robust data sharing process among them.

For objective four, creating pathways for family math learning, the workshops built upon the existence of and access to the websites you.cubed.org and 12 Months of Math. The you.cubed.org that Stanford University operates provides a well-supported and funded resource that is open to the public and educators and available on an international scale. The future of this resource seems secure well into the future. The Explora Museum hosts the 12 Months of Math website. This resource provides opportunities for visitors to explore different fields, such as engineering, architecture, medicine and agriculture, where math is an integral part of the skill set and daily operations of associated professionals. Understanding how various professionals apply math can serve as an inspiration for children to develop the necessary skills, knowledge, and aspiration to enter and succeed in such careers, regardless of their ethnicity or gender. Keeping the website fresh and relevant will require dedicated resources.

In addition to the objective list above, the following research questions guided the evaluation:

There was one guiding question for this evaluation: What are the Math FACCES outcomes and impacts that participants enjoy, whether they are teachers, students, or parents? Seven key measures selected for evaluation supported that primary question:

1. Do students express improved attitudes towards math?
2. Do parents experience improved attitudes towards math?
3. Do teachers have improved attitudes about teaching math?
4. Do students become more engaged in school?
5. Does student growth in math achievement increase, as indicated by the State summative math assessment?
6. Do achievement gaps in math decrease among race/ethnicity subgroups, English Language Learners, Free and Reduced Price Lunch and Special Education students?
7. How are quality and participation in professional development for teachers and parents related to impacts on student behavior and achievement?

The Families and Communities Ensuring Student Success (FACESS) project provided students, parents and teachers with many resources related to the development of enhanced skills and knowledge in mathematics. Voluntary in nature, the FACESS project resulted in limited numbers of educators (16 in Yr. 1 and 29 in Yr. 2) and parents (20 in Yr. 1) who participated. For a majority of those who did participate, the experience appears to have been productive.

Both parents and teachers developed more efficacy, great empathy with students, more willingness to engage with and listen to students, and better skills surrounding math. They learned about the importance of accepting mistake making in math and the need for deep understanding over speed when solving math problems. They developed deeper understanding of the need for open-ended questions and discussion. They came to develop a fuller appreciation of the sense of a mathematical growth mindset, and that everyone has the capacity to learn math.

In conclusion, the results collected from the surveys given to teachers, parents and students indicate that each group realized positive effects from the adults who participated in the workshops and other math-related professional development activities. PARCC subgroup analyses appears for Schools A and B in the last section of the report. The overall story suggests that School B benefited more, as shown by various decreases in subgroup disparities, than School A between the two school years . However, School A performed better overall in math than School B between the two years. Delays in implementation from numerous sources and the COVID19 pandemic that led to the premature suspension of project activities and data collection diminished the potential of the evaluation to show a broader effect from the FACESS project. With that caveat, the following report provides the results of the data able to be collected. These show that adults can gain much from participation in professional development that ultimately will benefit children, as students, daughters and sons.

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Introduction

The need to understand how mathematics serves as an integral part of modern life should be a fundamental part of education. Ideally, basic numeracy allows the development of in-depth mathematical competency that underpins access to careers in the various sciences and engineering fields that not only can offer a fulfilling life experience but contribute to the betterment of the broader society and its citizenry.

In 2017, a group headed by a team at the Explora Museum, the UNM STEM Collaborative, and several other organizations joined together to submit an application to the National Science Foundation to assess the impact of a professional development program in mathematics for elementary school teachers. This project was known as the Families and Communities Empowering Student Success, or its acronym FACESS. The professional development program built on the work of Jo Boaler, an education professor at Stanford University, who specializes in mathematics education, and whose outlines of this approach appear in her text, *Mathematical Mindsets*. In part, the professional development work also builds on the ideas of Carol S. Dweck, a psychology professor, who stresses the concept of a growth mindset, as outlined in her book, *Mindset: The New Psychology of Success*. Her book, built on decades of research, challenges the idea that intelligence is a fixed component and proposes that people can build a growth mindset that can serve to help realize their potential.

To determine whether such a shift in mindset toward mathematics could be achieved at a pilot level in two elementary schools, the FACESS project had four primary aims/objectives:

1. improve students' attitudes, practices, and achievement in math;
2. improve parents' attitudes, practices, and confidence in math and increase their utilization of family math resources;
3. improve data-sharing among partners related to math participation and achievement, and
4. create pathways within the NM STEM Ecosystem for family math learning.

The project focused on implementing a professional development pilot program that would include the teaching faculty of two elementary schools in a large metropolitan district in the Southwest and the parents of the students in those schools. The concept behind this approach was that teachers working in cooperation with parents could help improve academic achievement in basic mathematics for students. The students, in turn, would have improved attitudes towards mathematics and be better prepared to move from basic arithmetic to higher forms of math, including algebra, statistics, and calculus. In the long-term, this development is expected to open doors to opportunities in fields typically underrepresented by people of color, those in lower SES strata, and females. Such fields include various types of engineering or science, mathematics, social sciences, medicine, etc. As the impact of technology becomes more pronounced, the need for individuals equipped with skills to work in these math-dependent fields has both expanded and accelerated.

The approach followed in the FACESS project included engagement with teachers at and parents of students from the two pilot schools. Underpinning the teacher professional development were concepts of: 1) mathematical mindset (Boaler 2016) and 2) children's mathematical sense-

making through Math Talk and Listening (Hufferd-Ackels, et al. 2004; Hintz and Tyson, 2015). For parents, the workshops used strategies put forth by Kazemi and Hintz's (2014) *Intentional Talk*; Ghousseini et al. 2017, on support of math instruction in small groups; and techniques on Cognitively Guided Instruction (Carpenter, et al1999 and Empson and Levi, 2000).

The work aimed to solicit the ongoing participation of these two groups using a combination of incentives (payment to the teachers and gift cards for parents) to encourage engagement with a series of workshops and other resources that exposed participants to various mathematical concepts as well as their application. The workshops had purposes specific to their assigned audiences. Teachers received instruction in workshops that addressed math concepts they may or may not have been exposed to during their pre-service education and approaches to instruction that would help facilitate a growth mindset within their students. Their professional development included access to online study modules via the youcubed.org website that provided extensive resources related to math concepts, problem solving and teaching strategies to guide their personal professional growth. Part of their professional development included a focus on recent discoveries in cognitive science such as the concept of brain or neural plasticity.

Since parents are recognized as a child's first teacher, it is obvious to work with and support them in any attempt to improve the child's math understanding. Parents received instruction on how best to assist their children better appreciate the applications of math in everyday life and in different careers. Parents received access to Twelve Months of Math materials that provided exposure to career fields that use mathematics and various activities they could participate in with their children. Parents were also encouraged to participate in hands on events at locations such as the Explora Museum, the State Fair, Balloon Fiesta Park, or their children's schools.

The Growth Mindset

Perhaps one of the most important aspects of training for teachers centered on the concept of a growth mindset mentioned earlier that both professors Boaler and Dweck have researched. In their work, they posit a growth mindset against a fixed mindset. Briefly, a growth mindset is focused on development and oriented towards the idea of growth and adaptability towards various challenges they face and the importance of effort. In contrast, a belief in a fixed mindset does not allow for modification in one's mental development—what you are born with is effectively what you will live with your entire life and there is little you can do to change this.

The tragedy of a child believing in this latter perspective is that they as youth and later as adults begin to fear challenges and discount effort as useless. The effects of holding a fixed mindset can be particularly pernicious if a teacher holds this perspective. The message they internalize is one that suggests it is useless to work with a child who is struggling with math or to assist them in developing the skills that would allow them to understand math. Such instruction can result in the child adapting that limiting perspective and not making the effort to master math and the concepts needed for its application. Internalizing this perspective can result in the child not fully realizing her or his potential and not embracing the amazing intellectual tool that mastery in mathematics provides.

Holding a growth mindset does not support the idea that one so oriented would possess an inflated sense of their performance ability. Dweck points out, somewhat ironically, it is people "with the fixed mindset who accounted for almost all the inaccuracy (Dweck, 2006, pg. 11)." Boaler cites research using fMRI technology that indicates that the brains of individuals possess a growth mindset show activity in areas that remain inactivated in those who hold a fixed mindset (Boaler 2016, pg. 12).

Further, individuals who hold a growth mindset: feel comfortable being wrong, try seemingly wild ideas, are open to different experiences, and play with ideas without judging them (Boaler 2016, pg. 14). Children should not be afraid of making mistakes, as it is through making errors that one can grow, develop and build mastery.

Evaluation Background

In July 2018, due to the resignation of the Principal Investigator for the Family and Communities Ensuring Student Success (FACESS) project at the UNM Cradle to Career Policy Institute (CCPI) the assignment shifted to Scott Hughes, PhD. Finding that the submission status of the project application to the UNM Office of the Institutional Review Board (OIRB) main campus was underdeveloped, Dr. Hughes alerted the project team of this situation and that data collection could not begin that August as originally scheduled.

Dr. Hughes then undertook preparation of the application, including preparation of:

- a modified study protocol;
- final versions of the surveys for teachers, parent, and students;
- waiver of consent documents for teachers, parents and students;
- information sheets for teachers and parents/students;
- Spanish language translations of the information sheet, parent waiver of consent and survey, and attendant certification forms for translators.

Spanish translation services split between one Explora museum used on previous projects and a CCPI staff member, who was fluent in Spanish. The translators completed the final versions of the documents by late September and after a pre-application review with OIRB staff, Dr. Hughes submitted the initial packet in early October. After the OIRB identified some minor issues in the initial application, Dr. Hughes addressed those and resubmitted the application.

The school district where the participant schools are located also has a research review process. Dr. Hughes prepared the application for that submission as well. In November, after the OIRB issued its project approval, Dr. Hughes submitted the application to the district.

Beginning in fall 2018, staff from Explora Museum engaged parents and teachers in a series of regularly scheduled workshops, typically once a month, during the first year of the project. The staff gave instruction on how participants could access the youcubed.org website, the 12 Months of Math website, the different free events occurring on various dates and different locations across the city such as the state fairgrounds, museums, and parks.

Staff arranged the workshops so that teaching staff and parents could participate. The teachers workshops occurred on site at the schools shortly after the end of the regular school day and

the parent workshops typically began in the early evening (6:00 PM) so that the families could get home from work and have dinner. The workshops for each group typically lasted 45 to 60 minutes to complete. The same amount of time was necessary for the you.cubed.org online workshops. Parents were also expected to spend approximately another three hours of time on math-related activities with their children for the duration of their participation, these could include visits to the 12 Months of Math website and math-based free activities. For teachers, each of the workshops lasted approximately an hour, as did the you.cubed.org web-based activities. Self-study could engage the teachers as long as they chose. The face-to-face workshops occurred on site at each of the participating schools. The web-based activities occurred at home or the place of the individual's choosing.

During a team meeting in the late fall, it became apparent that the use of a pre/post approach to survey collection was not viable as the workshops had already begun thus voiding the possibility of collecting unbiased initial surveys for parents and teacher. This required Dr. Hughes, with the assistance of other team members, to recast the surveys for parents and teachers to serve the purpose of retrospective data collection to be completed when participants had finished the workshops. The team decided to continue the pre/post completion of student surveys. After completing the parent and teacher survey edits and receiving project team concurrence, Dr. Hughes submitted an updated modification application packets to both the UNM OIRB and the district review board. Both the OIRB and district review board issued their approvals in early December 2018 thus allowing distribution of information and consent forms in early January 2019.

Prior to approval by UNM OIRB or the district review board, members of the UNM research team or Explora project team did not recruit parents or teachers and did not collect any data used in this report. Formal recruitment and data collection began in January 2019.

In January 2019, Dr. Hughes, Dr. Kersti Tyson, the project Co-PI, and Ms. Tamara Grybko, Explora project manager, met with the site teachers to explain the project, distribute the waiver of consent documents, and answer any questions. All teachers agreed to participate. Team members then distributed student survey packets along with the parent-related materials. Via student backpacks, teachers sent home the waiver of consent documentation and information sheet in both Spanish and English. Since parents had the option of holding their child out of participation, a couple of parents contacted Dr. Hughes about this choice. In turn, he contacted the principals of each school and informed them of the parent requests to ensure those children did participate.

Based on their schedules, teachers set aside a short period of classroom time, distributed the student surveys, read instructions, and let the students complete them. Once completed, the teacher collected the surveys and bunched them in folders that noted the grade level to allow for accurate data input. They delivered them to the administration of their schools and a project team member later picked them up. Dr. Hughes collected these all at his UNM office where they underwent data input and analysis. Although the surveys had no names attached, the completed data sets reside on a secure server at the Cradle to Career Policy Institute, accessible only by authorized team members.

Students once again completed surveys toward the end of the spring semester following the same process discussed earlier. In later discussions team members had with kindergarten teachers, it became clear that many K students had a challenging time understanding the concept of the assessment scales used on the survey. In response, due to the likelihood of distortion of results for that grade, the team decided it prudent not to use the data collected at the K level for the project. Parents and teachers completed surveys that spring once they completed their respective workshops.

Due to nominal participation by staff and parents from one of the original two schools, the research team sought out a third school to participate in another full year of activity. After the principal at the third school agreed, Explora submitted a request for a no-cost extension to the National Science Foundation, the funding agency, which it granted. After the NSF no-cost extension, UNM CCPI submitted a modification application to both the OIRB and the district's research review board. Both of these groups granted approvals for the project extension.

In year two of educator engagement, teachers at the third school, as well as any new teachers at the two original schools, received a briefing and the waiver of consent documentation. All teachers received information sheets and surveys. As in year one, parents received a copy of the waiver of consent documentation in both Spanish and English. The second year had no parents object to their child participating in the study. The teachers in all three schools repeated the process for survey administration described for year one. Once again when finished they delivered the completed surveys to their administration where a project team member collected and delivered them to UNM CCPI for data input and analyses.

At the beginning of year two, teachers completed the baseline surveys and those findings along with year one are presented in the respective section of this report. Participating parents received only the year one survey and results appear in its respective section.

Second year activities occurred throughout the fall into the spring semester and then the COVID19 pandemic in March triggered closures of the schools across the district and suspension of all direct project activities.

An MOA between UNM CCPI and the school district provided access to and sharing of PARCC math test results for the initial two schools. As part of the agreement, a CCPI team member downloaded assessment data from spring 2018 and spring 2019. The New Mexico Governor suspended statewide testing for spring 2020, thus eliminating the possibility of using that data. CCPI team members analyzed and summarized the 2018/2019 data and present results in the last section of this report.

Team members performed data input and analysis on all the data sets and created the various graph series presented in this report. Various software programs served as the platforms for the analyses and graph production, these included Tableau, the statistical analytical program R, and Excel.

Compensation

For their effort, teachers received a stipend based on $22.00/hour pay for their time in professional development activities and parents received a $125 gift card once they had completed participation for the year.

Funding

The National Science Foundation (NSF) provided the funding for FACESS. A team comprised of representatives from various groups, including Explora, STEM-UP, Mission Graduate (UWCNM), Albuquerque Public Schools, UNM College of Education TEELP, NM EpSCOR, NM Informal Science Network, UNM STEM Collaborative, Albuquerque Parent Teacher Association, and Intel Corporation, participated in the development and submission of the application. Explora Museum served as the project host/manager and UNM CCPI served as the subcontractor for the evaluation.

Data Presentation

This report presents all data in aggregate form for maintaining anonymity and privacy. Specifically, the report presents parent data as completely masked. Because of their relatively small number, data for teachers has been aggregated and illustrated without distinction for school or grade. Student data appears disaggregated by grade groups 1–2 and 3–5, and denotes schools by the control codes of A, B and C, with the last appearing only for year two results.

Report Structure

The first section of the report provides a review of data compiled and analyzed from the teachers, the second provides that from the parents, and the third the students. The fourth and final section provides a high-level summary review of analyses performed on the PARCC state assessment results from the school years 2018 and 2019 for the two schools that participated during the first year of onsite activities.

Teacher Findings

The following discussion provides results from a twenty-five question survey provided to teachers as part of the FACESS project. By the time of the survey, they would have participated in a series of monthly workshops begun in September. Sixteen teachers from the two schools participated. The survey solicited impressions from teachers concerning how their experience in the Mathematical Mindset workshops had influenced their teaching and student engagement. Twenty-nine teachers completed a survey at the beginning of the second year. Due to the COVID19 crisis and subsequent closing of all schools in the district and state of New Mexico, the second administration of survey did not occur. Hence, year two results show results only from the first base survey.

Because of the small number of teachers who completed surveys, the results appear in aggregate form and not split by either grade group or school to help preserve participant anonymity. All percentages have been rounded up or down to the nearest whole number.

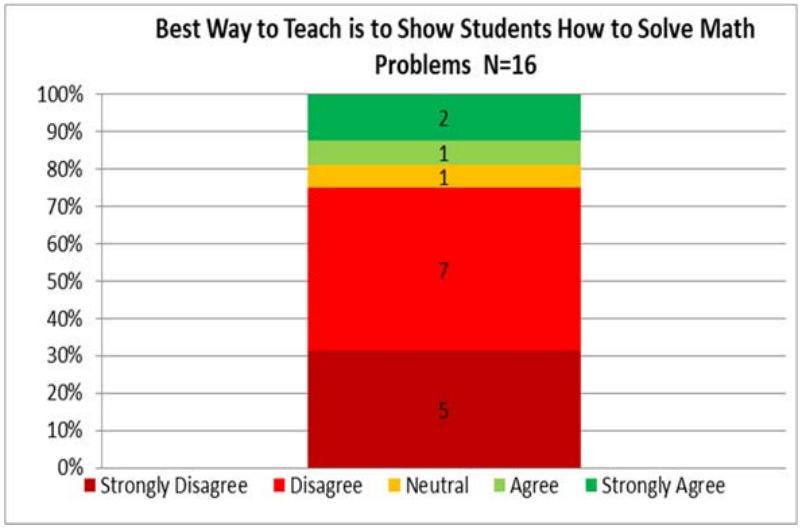
As noted earlier, a third elementary school in the district received an invitation to participate for the second year. The second year results present this inclusion.

The first year survey included an initial bloc of thirteen questions on how participation in the workshops helped the teachers in various domains of their practice. The following prompt framed the responses for this bloc:

Participation in the Mathematical Mindsets teacher workshops has helped me to:

The first query sought to determine whether teachers think showing students how to solve a math problem was a best practice. According to Jo Boaler, this would not be the case. Rather, working with the students to hear their thinking, see the attempt, then provide "course correction," if necessary, was a preferred method. Three-quarters (12/75%) of the teachers either disagreed or strongly disagreed with the statement. Another one (6%) each chose either a neutral response or agreed and another two (32%) strongly agreed.

Q1) think the best way to teach is to show students how to solve a math problem.



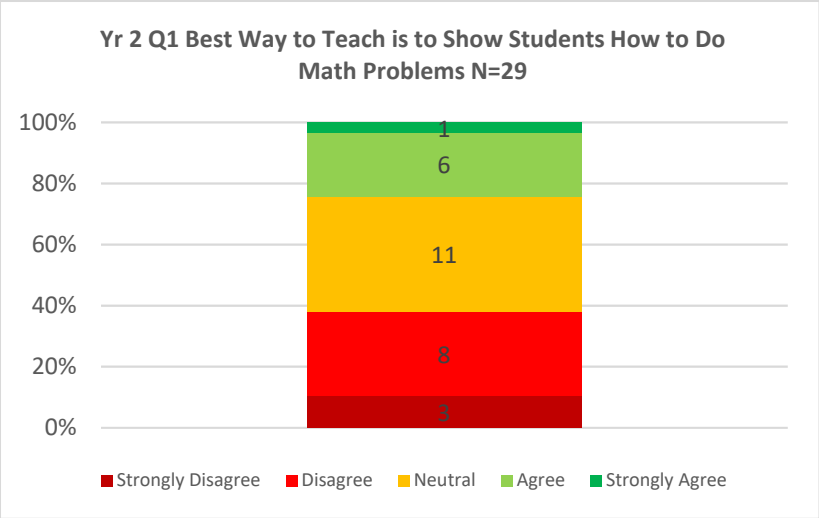
Year two participants had a different statement to frame their initial set of responses.

Please read each statement below and mark the numbered box that best fits your agreement with that idea. Your ratings may ranges from 1 (Strongly Agree) to 5 (Strongly disagree).

Participants during the second year received this survey prior to participation in the workshops and the survey intended to establish baseline perceptions that would be measured against another survey after completion of the workshops to measure perceptions post participation. As noted earlier the COVID19 crisis and subsequent shutting of schools eliminated the possibility of the second survey administration.

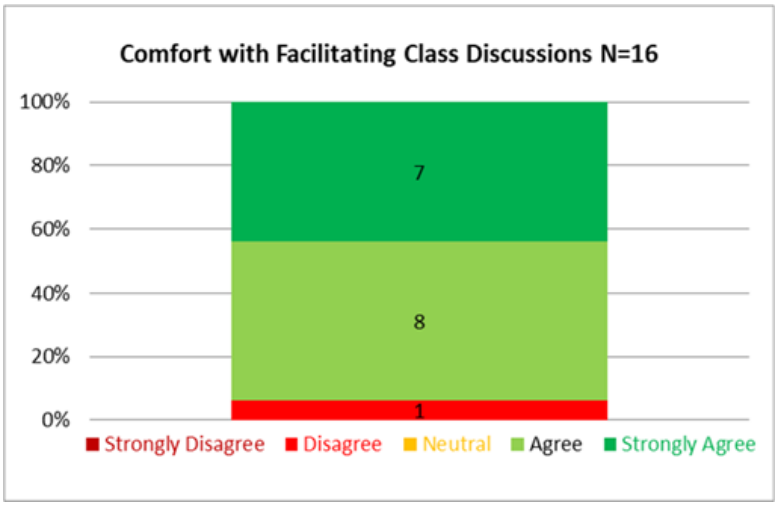
As the results show, the responses differ from in that percentage of educators from year one (12/75%) who disagreed or strongly disagreed with the prompt was nearly double that of second year participants (11/38%). Another eleven (38%) selected neutral and the remaining seven (24%) either agreed or strongly agreed. Some of the guiding principles of the workshops include allowing students to work on a problem, explain their thinking, and share their thoughts, and develop a deeper understanding of effective approaches to math problems rather than just mimicking the process a teachers shows on a board.

Q1) The best way to teach is to show students how to solve a math problem.



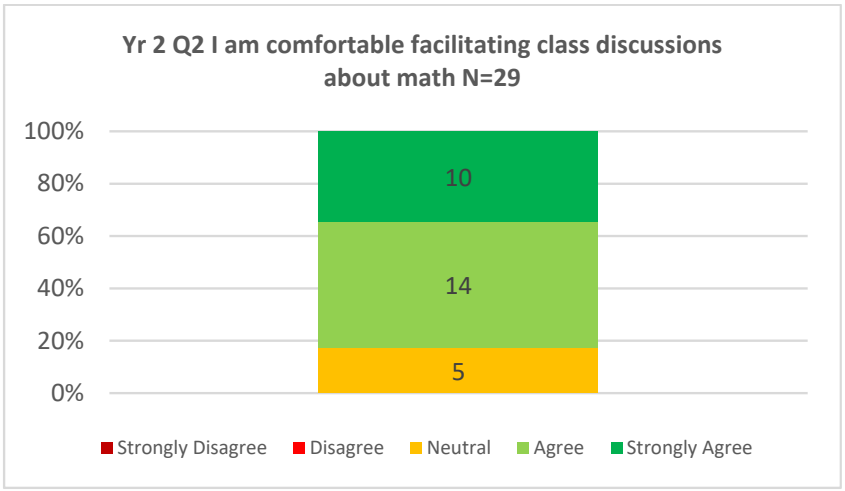
Participation in the workshops and giving them the skills to facilitate class discussions about math came next. A near total majority (15/94%) either agreed or strongly agreed with this statement and one (6%) who strongly disagreed.

Q2) be comfortable facilitating class discussion about math



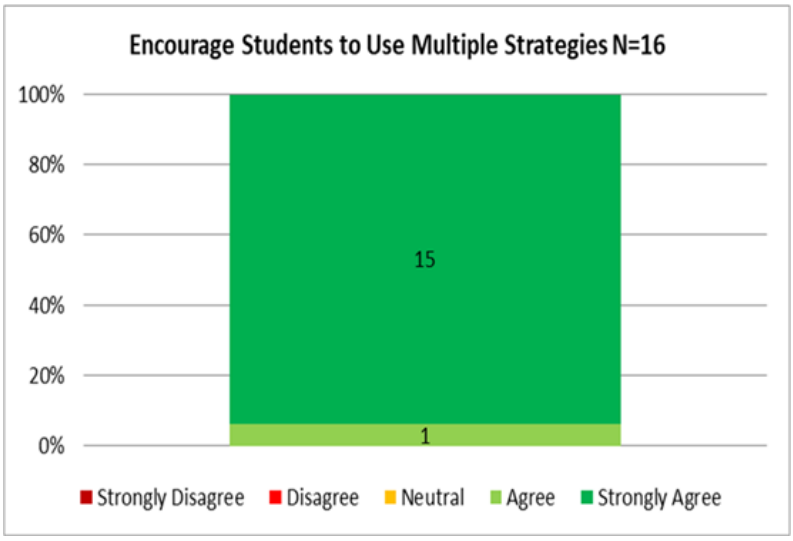
While the year two results show a high percentage of teachers (24/83%) who express comfort with leading classroom discussions on math, another five (17%) expressed neutrality for this question.

Q2) I am comfortable facilitating class discussions about math.



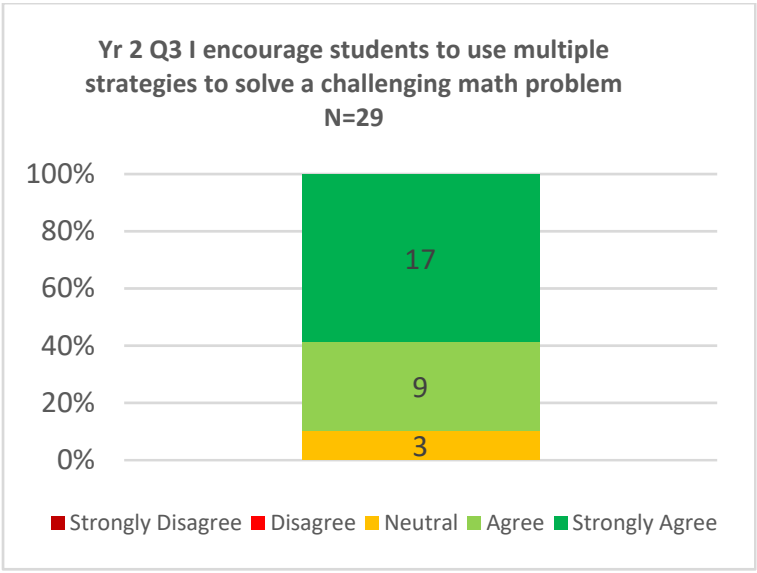
The next prompt in the bloc asked whether the teacher encouraged students to use several strategies for solving a math problem. All of the teachers (16/100%) either agreed or strongly agreed. Having several strategies available is useful in that it reflects a mindset that promotes creativity rather than simply following a rote method to solve math problems.

Q3) encourage students to use multiple strategies to solve a challenging math problem.



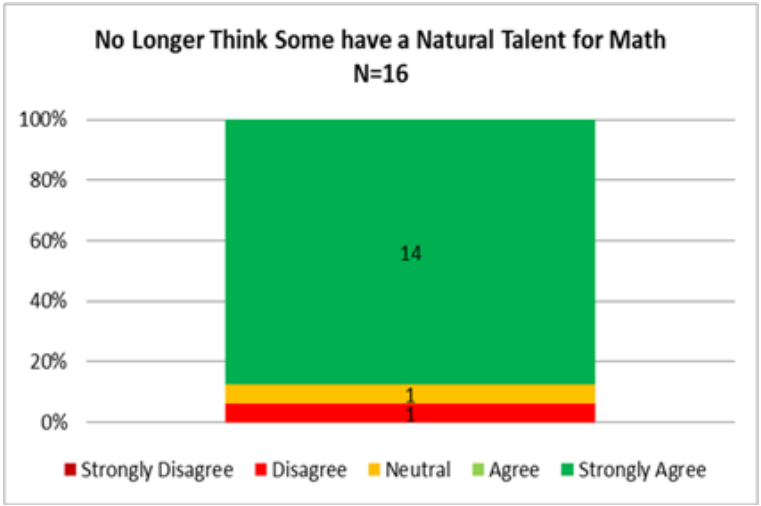
The second year participants also included a large percentage (26/90%) who encouraged students to develop multiple strategies to solve challenging math problems. The remaining three (10%) indicated they were neutral in their thinking toward this approach.

Q3) I encourage students to use multiple strategies to solve a challenging math problem.



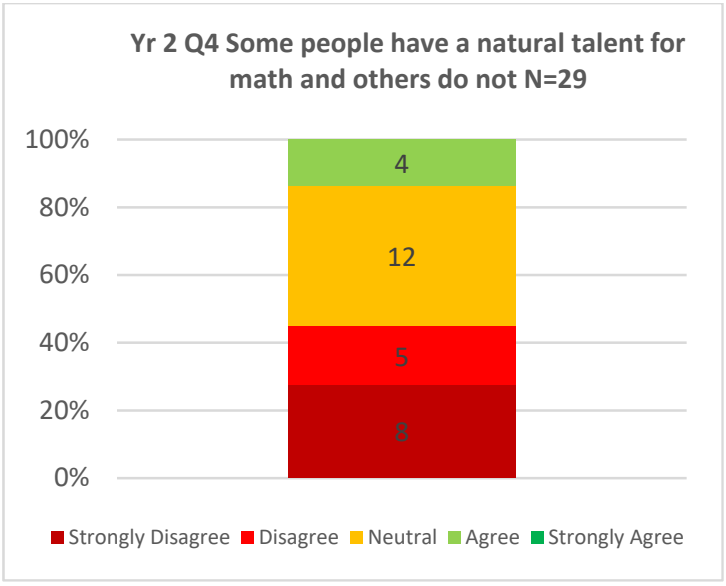
Delving into the impact of participation in the workshops on teachers' thinking about fixed or growth mindsets, the next prompt queried whether they no longer thought some people have a natural talent for math. A substantial majority (14/88%) strongly agreed, and another one (6%) each selected either a neutral response or disagreed.

Q4) no longer think some people have a natural talent for math and others do not.



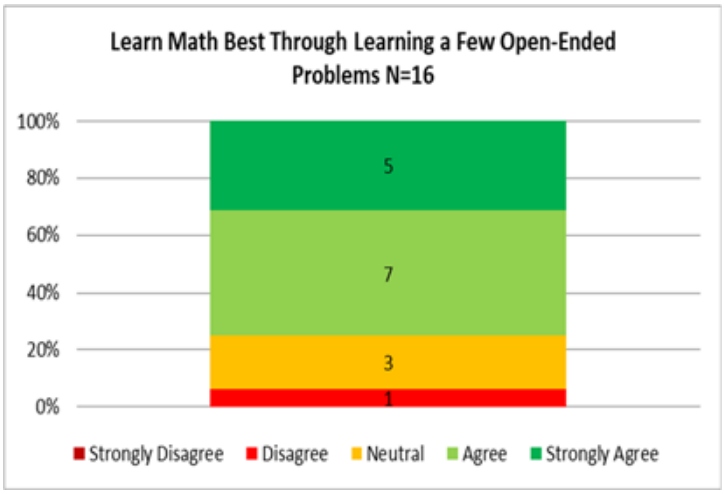
The year two results for this prompt about some people having a natural talent for math may reflect some ambiguity in thinking around the resilience of a fixed versus a growth math mindset in that a large percentage (12/41%) of participants were neutral and another four (14%) agreed. However, thirteen (45%) either disagreed or strongly disagreed with the query. As the workshops would stress, students can acquire math skills; they only need the opportunity to develop these skills.

Q4) Some People have a natural talent for math and others do not.



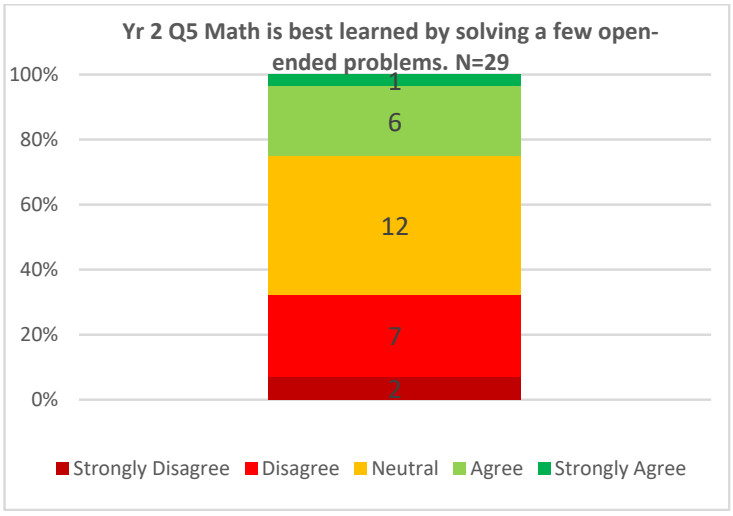
Another change of mind question centered on whether students are more likely to learn math best by the teacher engaging in open-ended questioning. A large majority (12/75%) agreed or strongly agreed with another three (18%) being neutral and one (6%) who disagreed.

Q5) more likely think math is best learned by solving a few open-ended problems.



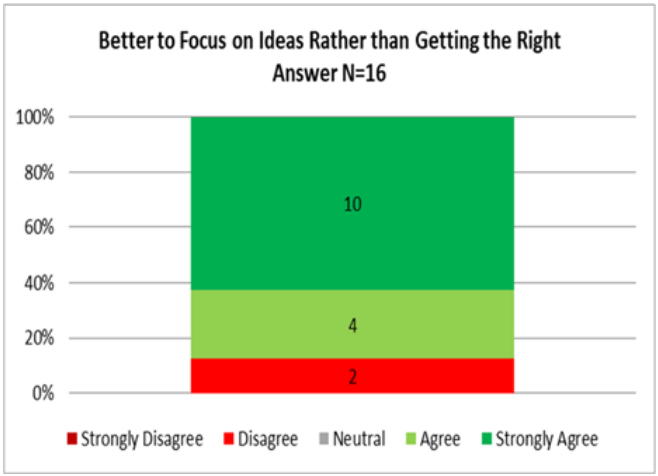
The year two base results reflect a different perspective in that a large number of respondents (12/41%) were neutral and another nine (31%) disagreed or strongly disagreed with the idea that using open-ended questioning was a best practice for promoting math understanding. Another seven (24%) agreed or strongly agreed.

Q5) Math is best learned by solving a few open-ended problems.



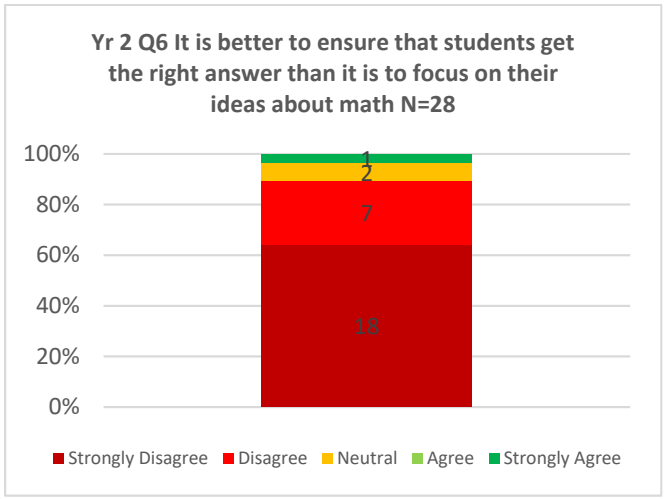
Shifting the focus to the student's mindset and mathematical problem solving, the next query probed whether teachers thought it best to focus on students' ideas rather than stressing they get the right answer. In response, a solid majority (14/88%) agreed or strongly agreed with focusing on ideas and two (12%) disagreed.

Q6) more likely think it is better to focus on students' ideas about math than to ensure that students get the right answer.



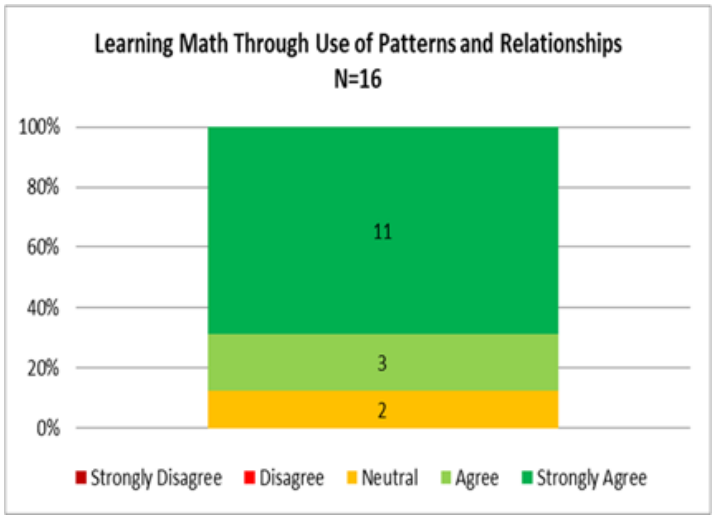
In the year two group, the results show a similar perspective in that nearly the same percentage (25/89%) disagreed or strongly disagreed with the query as those in the first year group (88%) who agreed or strongly agreed. The point being is that the way the second year survey framed the prompt between the two administrations did not produce dissimilar results. For the remaining three respondents from the second year, two (7%) were neutral and another one (4%) strongly agreed.

Q6) It is better to ensure that student get the right answers than it is to focus on their ideas about math.



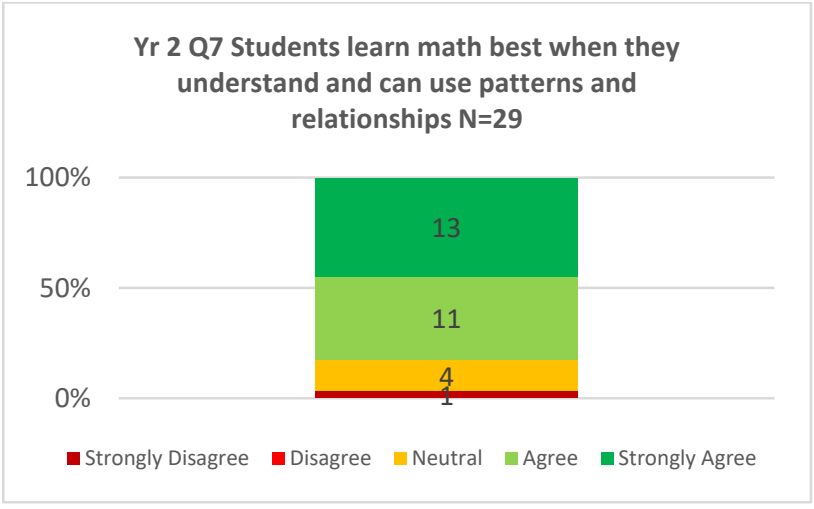
Sometimes an effective approach to mathematical problem solving centers on the context of the problem and the ability to understand and use patterns and relationships. Another solid majority (14/88%) agreed or strongly agreed with the following query, while two (12%) chose the neutral response.

Q7) more likely think students learn math best when they understand and can use patterns and relationships.



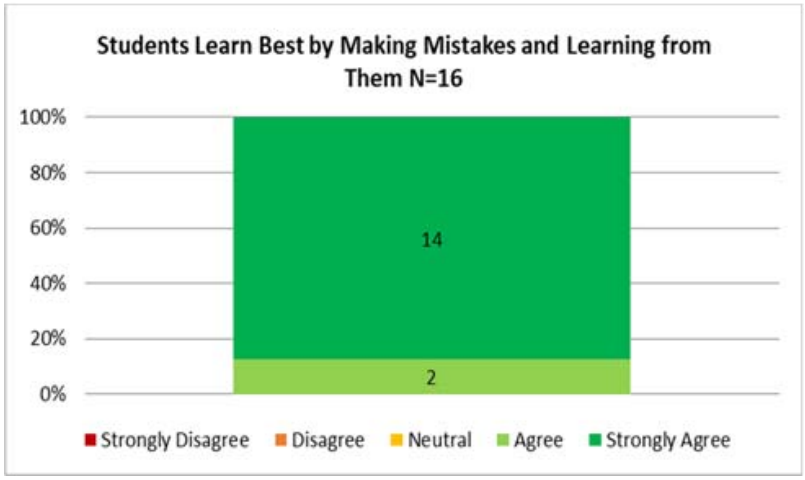
The year two results also show a solid majority of educators (24/83%) who thought that students learn math best when they can understand and use patterns and relationships. Another four (14%) were neutral toward and one (4%) strongly disagreed with the idea.

Q7) Students learn math best when they understand and can use patterns and relationships.



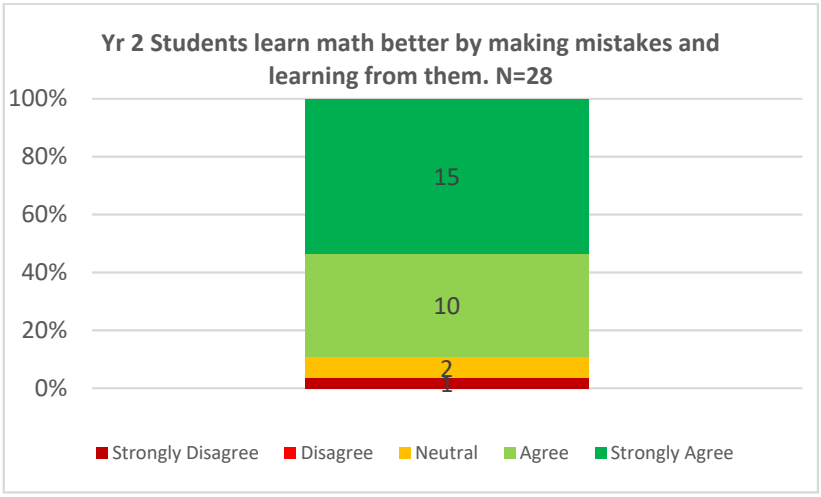
Making mistakes is an important part of the learning process, as anyone familiar with the career of Thomas Edison can attest and is attributed with the quote related to his development of the incandescent lightbulb, "I have not failed. I just found 10,000 ways that won't work." All sixteen teachers (100%) who responded to this query agreed or strongly agreed this approach was the best way forward.

Q8) more likely think students learn better by making mistakes and learning from them.



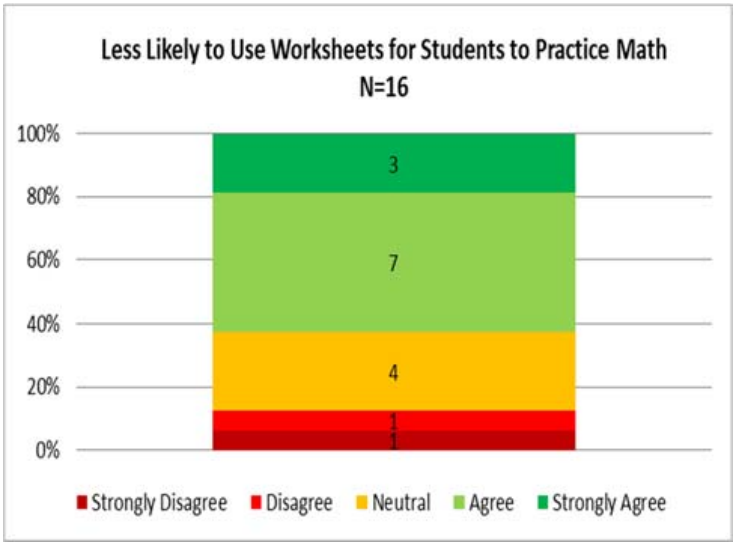
A large majority of educators (25/86%) in year two also agreed or strongly agreed with the prompt about making mistakes and learning from them. Two (7%) gave a neutral response and one (4%) strongly disagreed.

Q8) Students learn math better by making mistakes and learning from them.



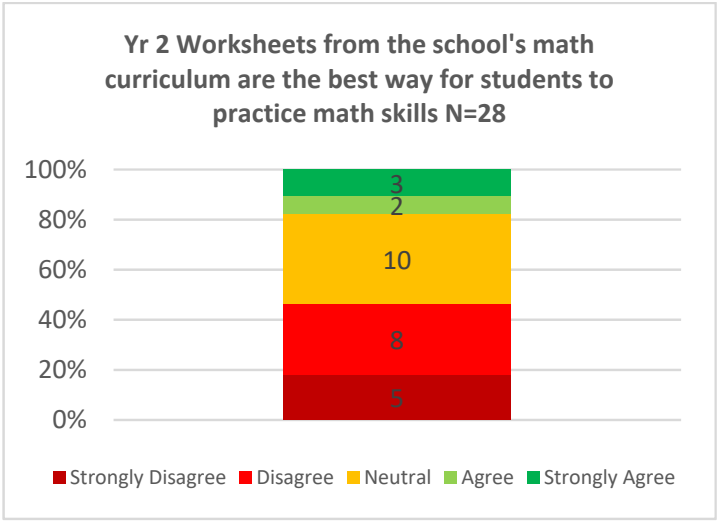
Use of worksheets can be part of a "drill and (s)kill" approach to teaching. Too often, the result is a bored student and an ineffective teaching and learning method. The next query posed whether teachers had come to the realization that they would be less likely to use worksheets as a method of student practice.

Q9) be less likely to use worksheets from the school's math curriculum as the best way for students to practice math skills.



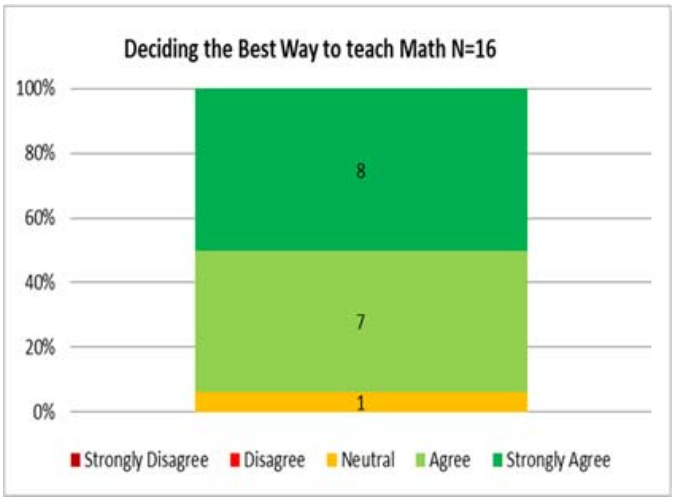
For year two, nearly half (13/45%) of respondents disagreed or strongly disagreed that worksheets served as the best way for students to practice math skills, while another ten (35%) expressed neutrality. The remaining five (17%) agreed or strongly agreed with the practice.

Q9) Worksheets from the school's math curriculum are the best way for students to practice math skills.



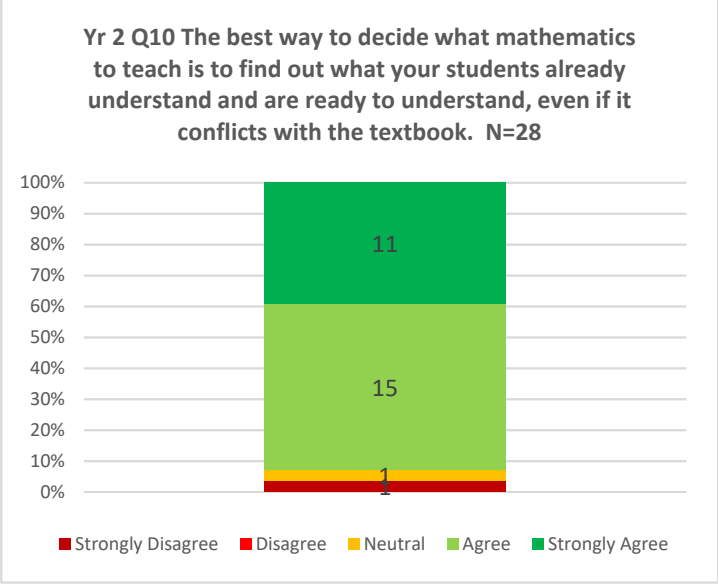
Overreliance on a textbook can lead to uninspired teaching and students who are under– or unengaged. Whereas approaching the teaching dynamic through focusing on if they already or are able to understand can turn the learning into a time of discovery and self-empowerment. The following question sought to uncover if after participating in the Math Mindset workshops teachers became less reliant on textbooks and, instead used where students' understanding was as their guiding light for instruction. A large majority of teachers either agreed or strongly agreed (15/94%) with the statement of relying on student understanding and one (6%) chose a neutral answer.

Q10) more likely to think the best way to decide what mathematics to teach is to find out what students already understand and are ready to understand, even if it conflicts with the textbook.



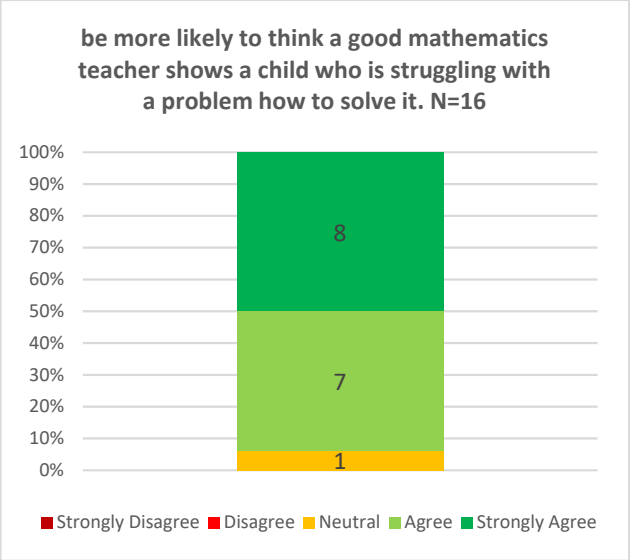
A solid majority of year two participants (26/93%) either agreed or strongly agreed that getting a bearing of what students understand and ready to understand related to math as a best practice, while one each (4%) selected neutral or strongly disagreed with the approach.

Q10) The best way to decide what mathematics to teach is to find out what your students already understand and are ready to understand, even if it conflicts with the textbook.



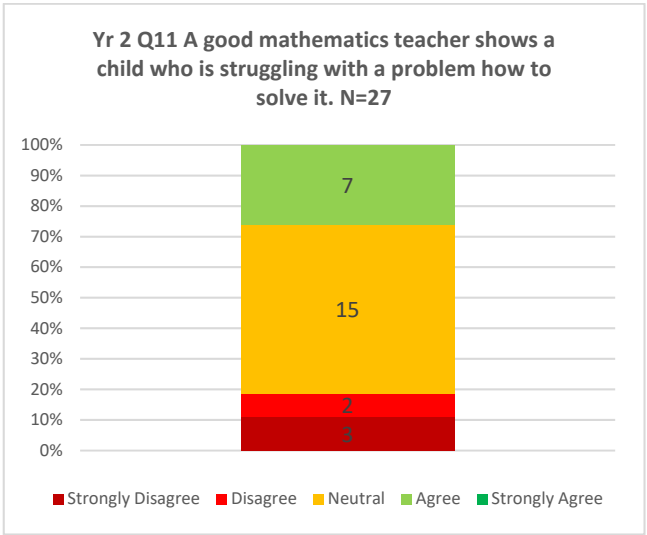
Sometimes struggling with a problem is the best way to develop the skills on how to solve it. If a teacher too rapidly moves in with the solution rather than seeking out a child's thinking on her approach, the opportunity for building efficacy in problem solving can be lost. A strong majority (12/75%) of the teachers disagreed with the idea that a good mathematics teachers shows a struggling child how to solve a problem, while the other quarter (4/25%) agreed or strongly agreed with the approach, which is contrary to what they would have learned in the workshops.

Q11) be more likely to think a good mathematics teacher shows a child who is struggling with a problem how to solve it.



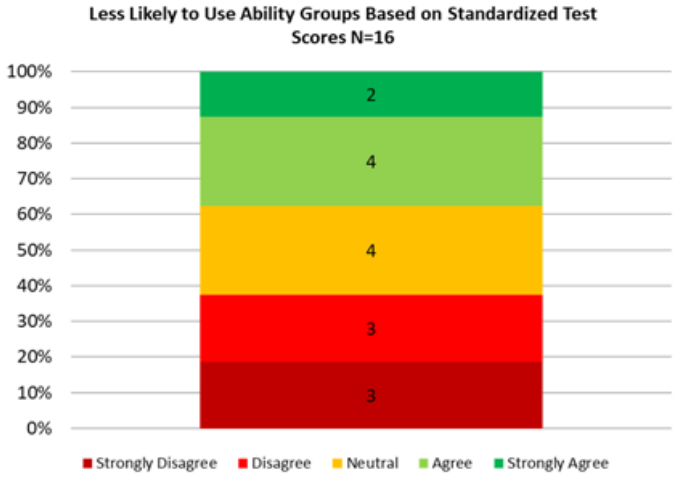
A majority of respondents (15/56%) selected a neutral response to this query, while seven (26%) agreed and another five (19%) disagreed or strongly disagreed.

Q11) A good mathematics teacher shows a child who is struggling with a problem how to solve it.



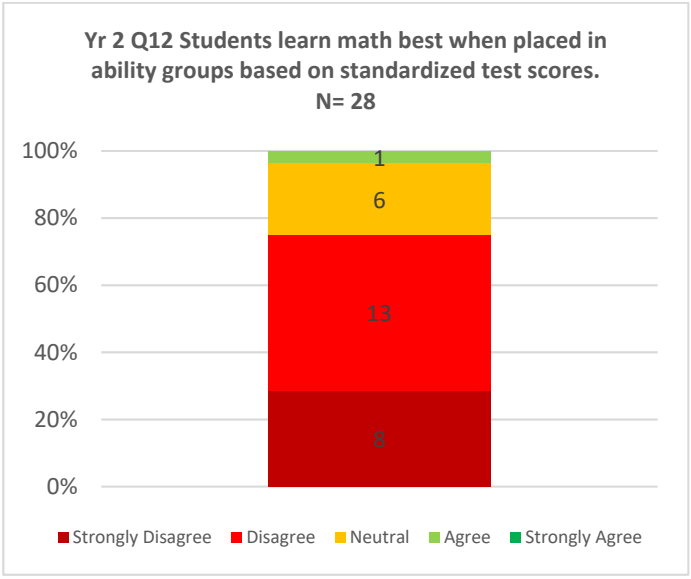
Placing students into "ability groups" is a form of tracking. Contrary to the research on teaching for empowerment, piquing interest, and effective learning in mathematics and elsewhere, an approach broadly known as opportunity to learn (OTL), placing students into such groups tends to lessen their likelihood of advancement and will likely keep them at the level at which they were placed. Ability grouping is suggestive of believing in a fixed mindset as opposed to embracing belief in a growth mindset that had been a central concept of the workshops. The results that emerged from this query were mixed in that (6/38%) either agreed or strongly agreed with the following prompt, with four (25%) who chose the neutral selection and the remaining six (38%) who either disagreed or strongly disagreed.

Q12) be less likely to think students learn best when placed in ability groups based on standardized test scores.



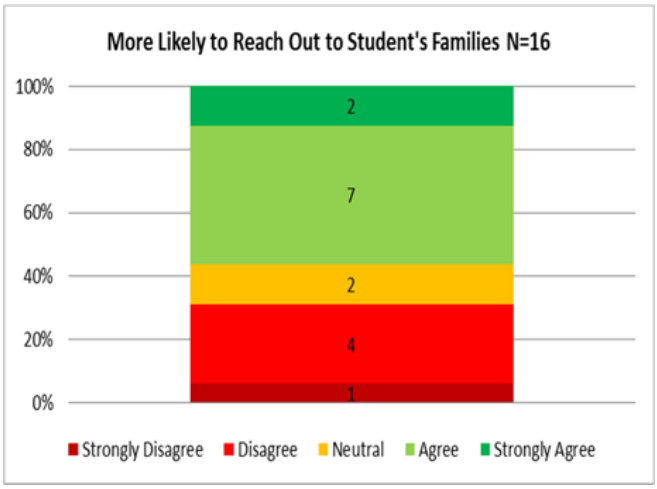
Three-quarters (21/75%) of the respondents from year two disagreed with the prompt that a best practice for math learning is to place students in ability groups. Another six (21%) were neutral about the idea while the remaining one (4%) agreed with the practice.

Q12) Students learn math best when placed in ability groups based on standardized test scores.



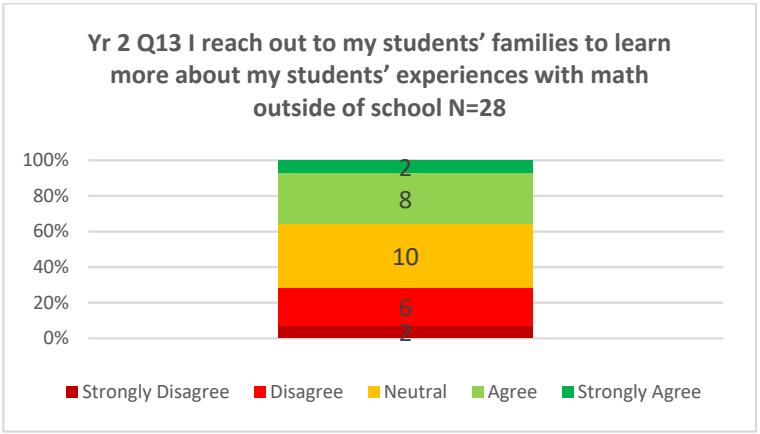
Engaging parents about their child's experiences outside of school with various subjects, but specifically mathematics, can provide a teacher with insights on why a particular child may be performing at one level or another. Teachers feeling at ease with reaching out to parents can help both them and families develop sufficient supports to encourage children in school. Such outreach can promote a sense of efficacy in parents to develop the skills and understanding necessary for showing students how math operates in everyday life and the effect that mastery of the subject can have on their life path. Whereas, a majority of teachers (9/56%) agreed or strongly agreed with the following statement, another two (13%) chose a neutral response and the remaining five (31%) disagreed or strongly disagreed.

Q13) more likely to reach out to my students' families to learn more about my students' experiences with math outside of school.



For the year two participants, more than one-third (10/36%) chose the neutral response to this prompt, while another eight either (29%) disagreed or strongly disagreed, while the remaining (10/36%) agreed or strongly agreed that they reached out to the families.

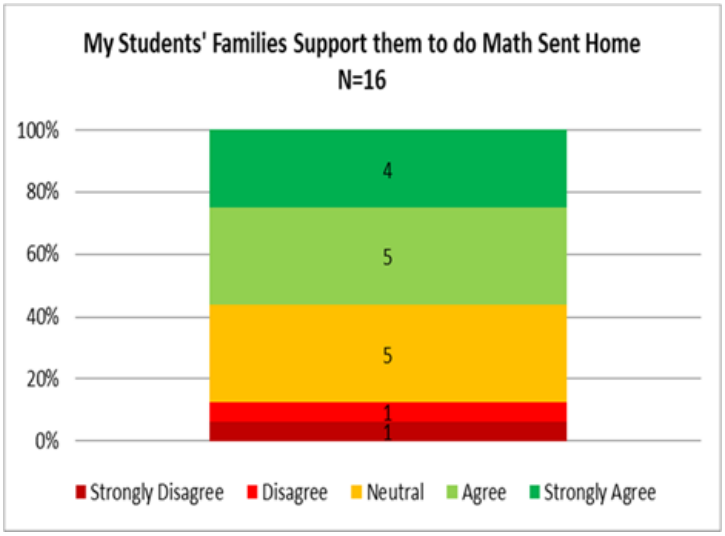
Q13) I reach out to my students' families to learn more about my students' experiences with math outside of school.



The next four queries focused on discerning the perspectives of an individual teacher on various dimensions surrounding their students' family situation and their own mindset related to math.

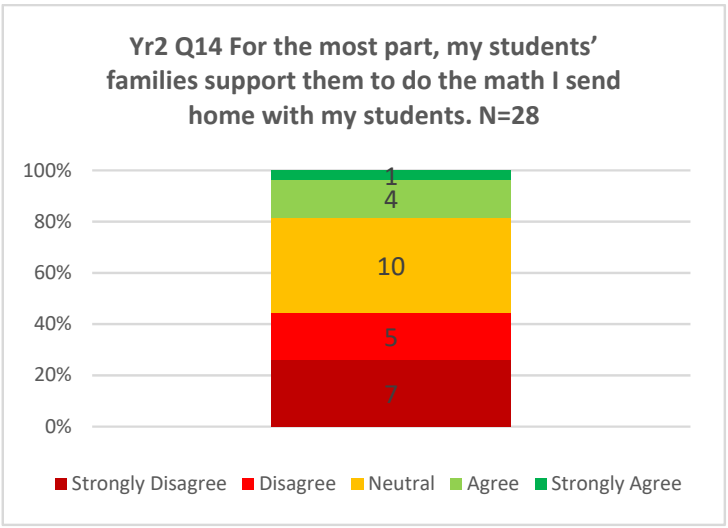
The first focused on whether the teacher thought that students' families provided support for the math homework they sent home. A majority (9/56%) agreed or strongly agreed with the following statement, five gave a neutral response, and the last two (6% each) disagreed or strongly disagreed.

Q14) For the most part, my students' families support them to do the math that I send home with my students.



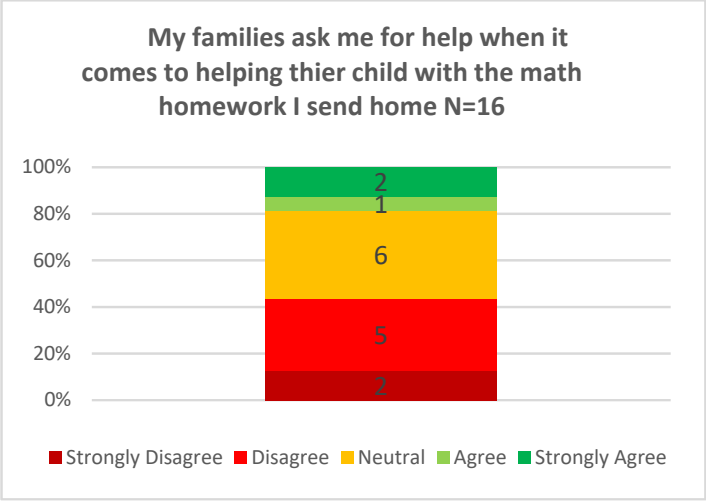
Responding to the query on whether they thought their students' families supported them with the math homework, twelve (43%) disagreed or strongly disagreed this was the case. Another ten (36%) were neutral, whereas the remaining five (18%) agreed or strongly agreed families offered support on math homework.

Q14) For the most part, my students' families support them to do the math I send home with my students.



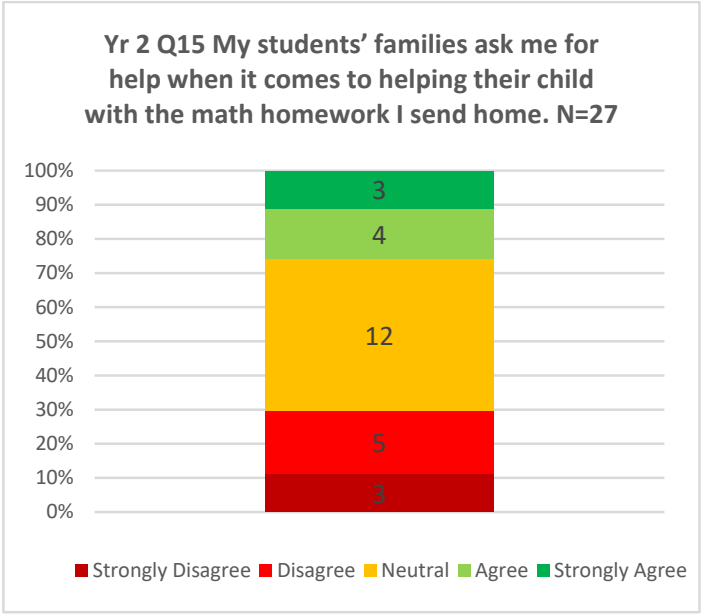
Building on the previous query, the next inquired whether families of students asked teachers for assistance to help their child complete their math homework. In response, a large minority (7/44%) disagreed or strongly disagreed. Six (38%) offered an ambiguous neutral response, ambiguous in that the families either asked for help or they did not. The remaining three (19%) agreed or strongly agreed parents asked them for help.

Q15) My students' families ask me for help when it comes to helping their child with the math homework I send home.



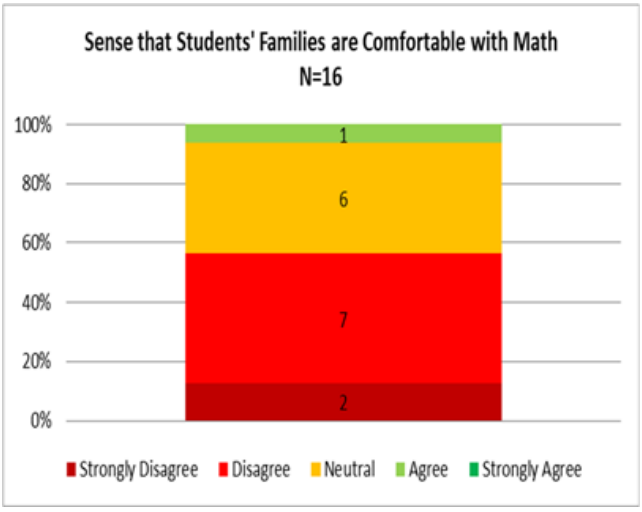
In responding to the year two prompt concerning their students' families asking for assistance to help with homework, the largest number (12/43%) were neutral, and eight (29%) disagreed or strongly disagreed, while another seven (25%) either agreed or strongly agreed with the query.

Q15) My students' families ask me for help when it comes to helping their child with the math homework I send home



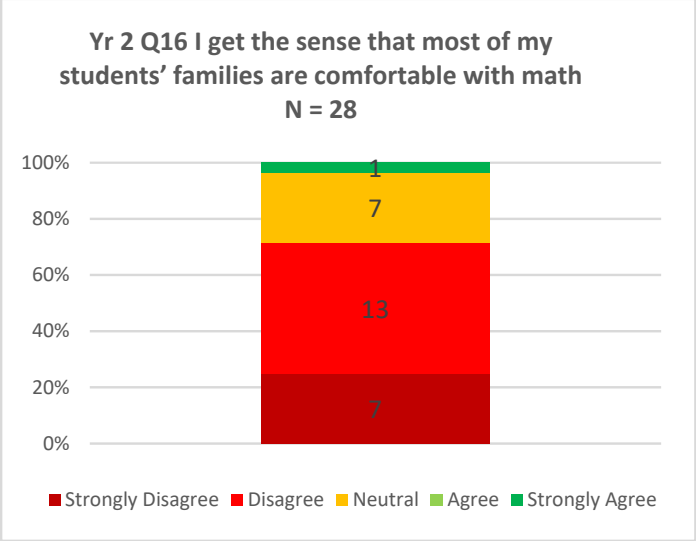
As detailed in the text, Innumeracy: Mathematical Illiteracy and its Consequences (Paulos, 1988), a large percentage of the American population is "math challenged." Some examples of how the significance of this issue plays out is illustrated in the uncritical acceptance of sketchy statistics, the failure of people to grasp the impact of interest rates when they take out loans, or the inability to measure accurately any of the other myriad of numbers-based challenges faced daily. The responses from the following query shows the perspective teachers have regrading their students' families comfort level with math. A majority (9/56%) disagreed or strongly disagreed with the prompt, six (38%) offered a neutral response, and only one (6%) agreed, and not strongly.

Q16) I get the sense that most of my students' families are comfortable with math.



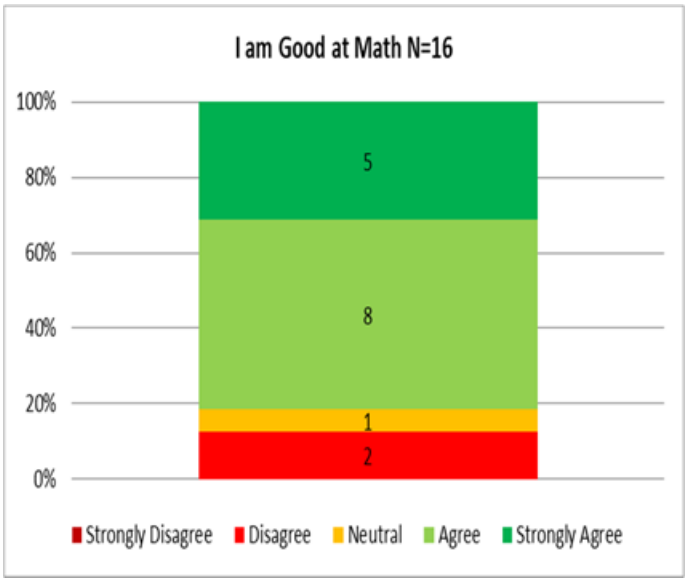
Nearly three-quarters of the second year participants (20/71%) disagreed or strongly disagreed that their students' families were comfortable with math. Another seven (25%) were neutral and one (4%) agreed.

Q16) I get the sense that most of my students' families are comfortable with math.



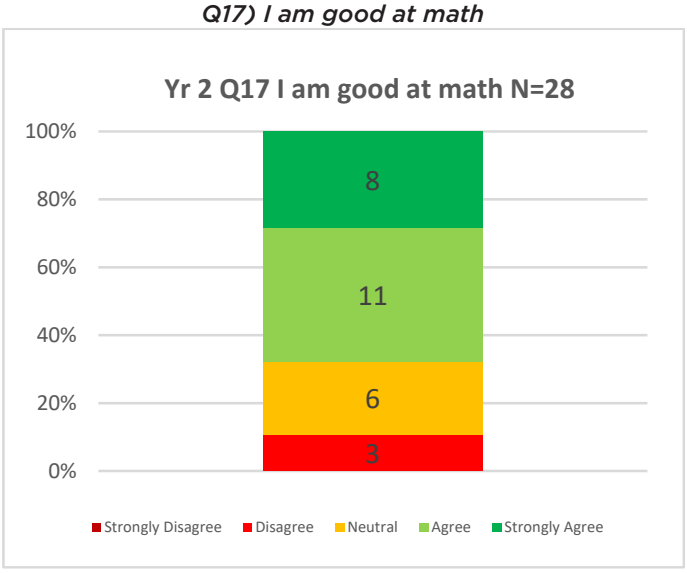
Personal efficacy and a sense of confidence are key contributing elements to success in a career and in life. The next prompt queried teachers on whether in the wake of their participation in the Math Mindset workshops they believed themselves good at math. A solid majority (13/82%) agreed or strongly agreed, one (6%) provided a neutral response, and another two (13%) disagreed.

Q17) I am Good at Math



Of the year two participants, over two-thirds (19/68%) either agreed or strongly agreed they were good at math. Another one (7%) selected the neutral response, and the other two (14%) disagreed.

Q17) I am good at math

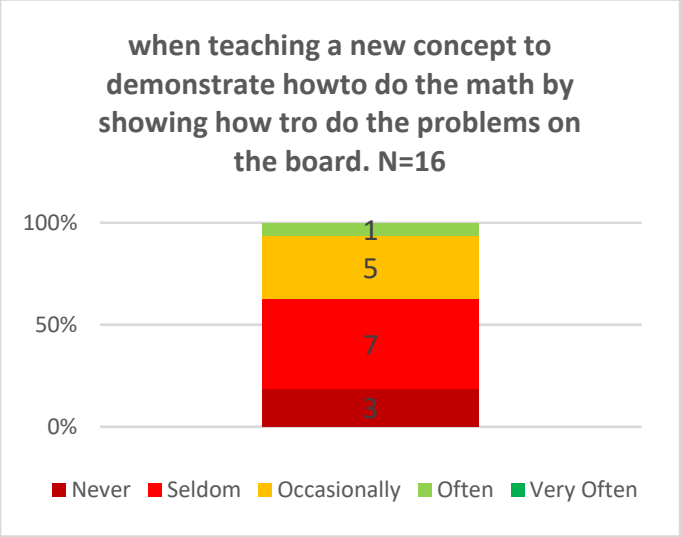


For year one the next eight queries shifted from levels of agreement to frequency and used the following framing prompt for teachers to provide a response:

After participation in the Mathematical Mindsets teacher workshops, how likely are you when teaching a new concept

The first of these queries sought to determine whether teachers would likely default to showing students how to solve a math problem by performing the task on a board. Such an approach is contrary to allowing students to explore the problem themselves first and attempting to work out the solution versus simply parroting what they saw their teacher do. In response, nearly two-thirds (10/62%) indicated they would never or seldom do this, an action in line with what they would have been exposed to in the workshops. Another five (31%) indicated they would occasionally and the remaining one (6%) would often do so.

Q18) when teaching a new concept to demonstrate how to do the math by showing how to do the problems on the board.

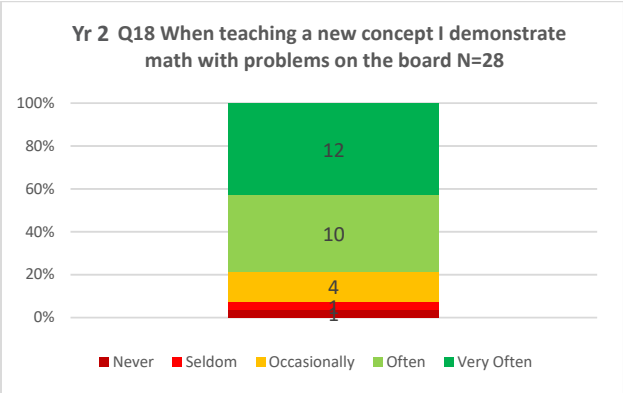


During year two, the following eight questions used this framing prompt to ask for a response:

Please read each statement below and mark the numbered box that best fits how often an event occurs. Your ratings may range from 1 (Very Often) to 5 (Never).

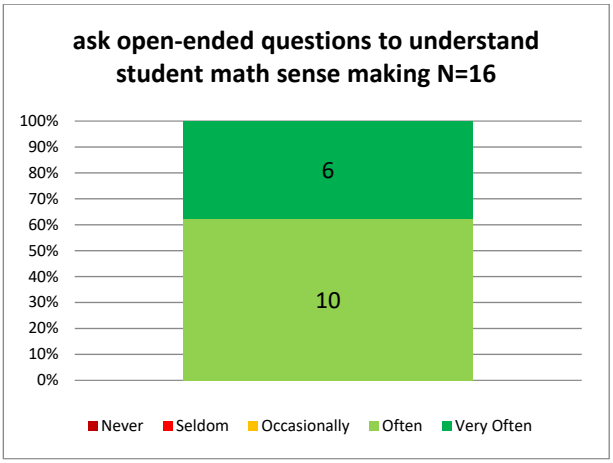
Thinking that showing students how to solve a math problem is the best way to teach a new concept in math is prevalent in the second year of participants with more than three-quarters (22/79%) who indicated that they would often or very often follow this practice. Another four (14%) would occasionally do so and another one each (7%) would seldom or never, which is closer to the ideal they would be exposed to through the workshops.

Q18) When teaching a new concept I demonstrate math with problems on the board.



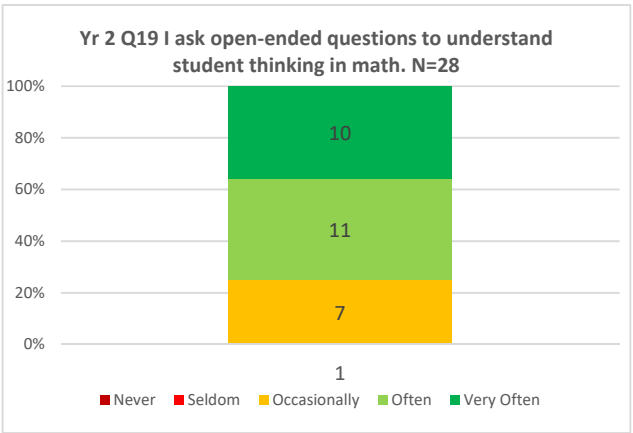
Next in the series asked about the frequency of asking open-ended questions related to the effort of teachers helping their student engage in sense making related to math. A full majority of teachers (16/100%) either would often or very often engage in this approach as an effective practice for encouraging student understanding of math concepts.

Q19) to ask students open-ended questions to understand their sense-making about the math?



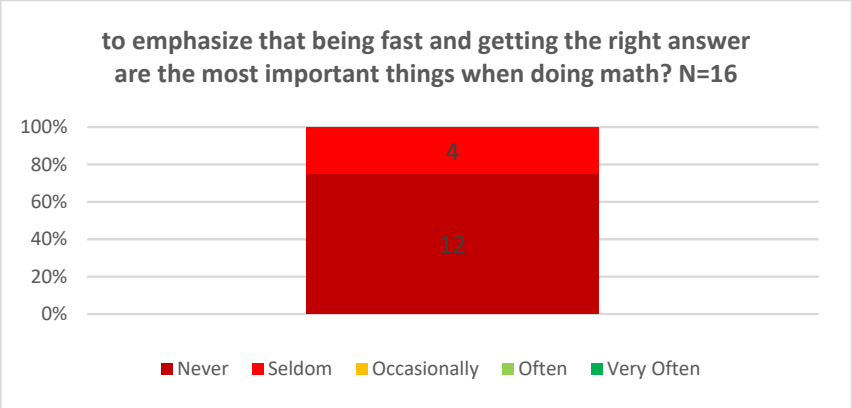
For year two, a significant minority (7/25%) noted they would occasionally ask open-ended questions, while the remaining three-quarters (21/75%) would often or very often do so.

Q19) I ask students open-ended questions to understand student thinking in math.



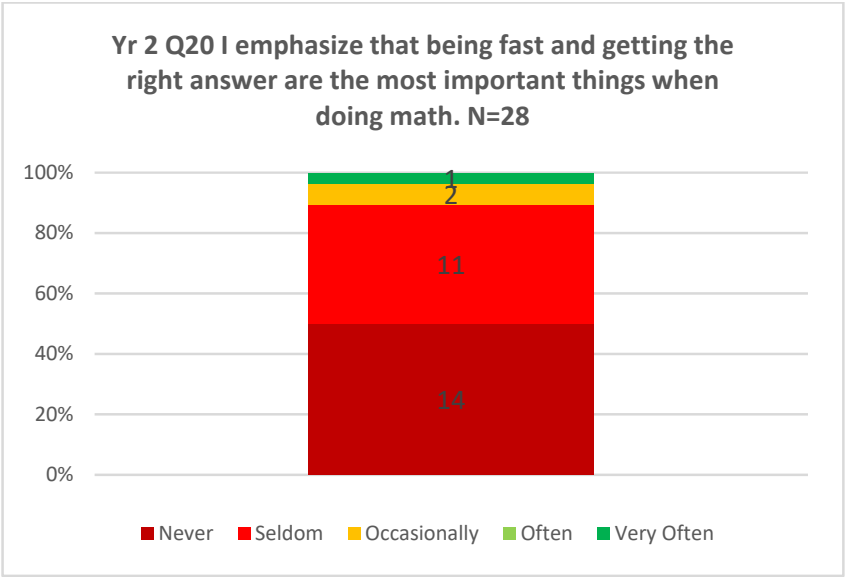
While it can be beneficial to be fast and accurate in solving math problems, a more important element students need to strive to develop is an in-depth understanding of why and how a particular solution and method applies. As with the previous prompt, and as a contrary and correct conception about speed and accuracy in solving math problems, a full majority (16/100%) selected either seldom or never for emphasizing these aspects as most important.

Q20) to emphasize that being fast and getting the right answer are the most important things when doing math?



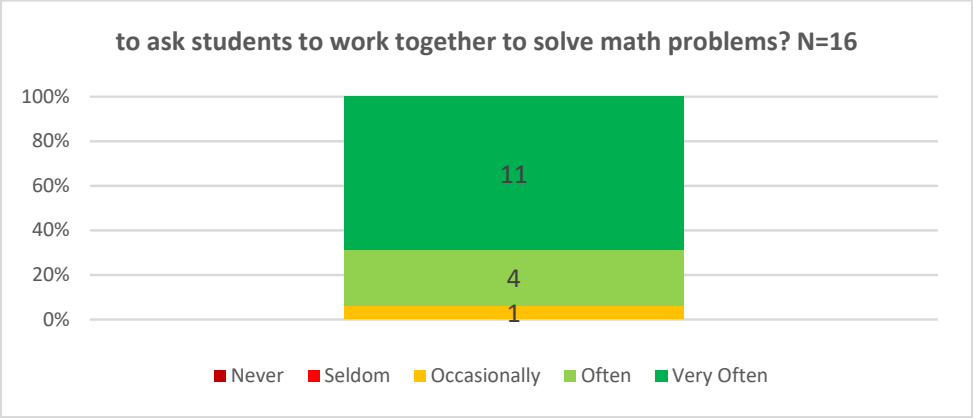
Speed and accuracy as one of the most important goals of math instruction was not a pedagogical goal for a majority of year two participants either. A significant majority (25/89%) indicated they would seldom or never emphasize that perspective while another two (7%) indicated they would occasionally do so and one (4%) would often emphasize this focus.

Q20) to emphasize that being fast and getting the right answer are the most important things when doing math?



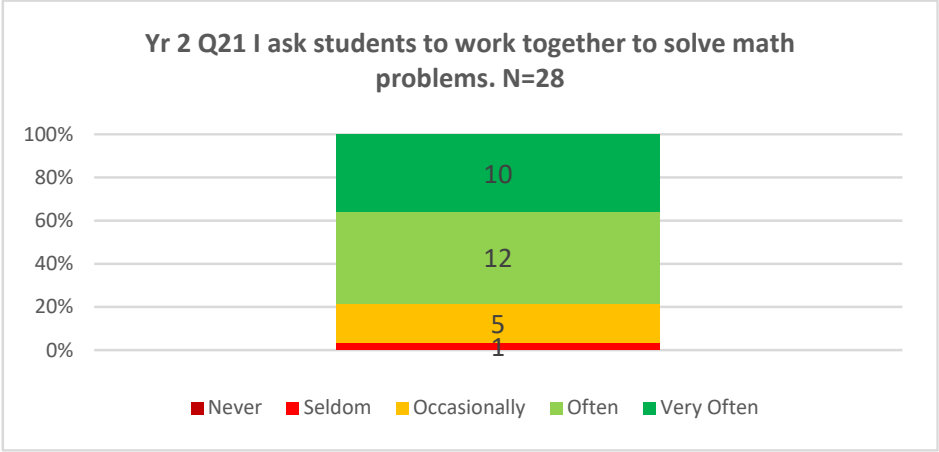
In a previous time, many teachers placed students to work out all of their subject-area problems on their own, mistakenly thinking that group work encouraged laziness, or worse cheating. However, thinking on the use of breakout groups has changed and an openness to using this strategy is more widespread and acknowledges the strength of peer-supported learning as a way of encouraging the development of student cognition and cooperation. A solid majority (15/94%) indicated they would often or very often encourage students work together and one (6%) selected occasionally.

Q21) to ask students to work together to solve math problems?



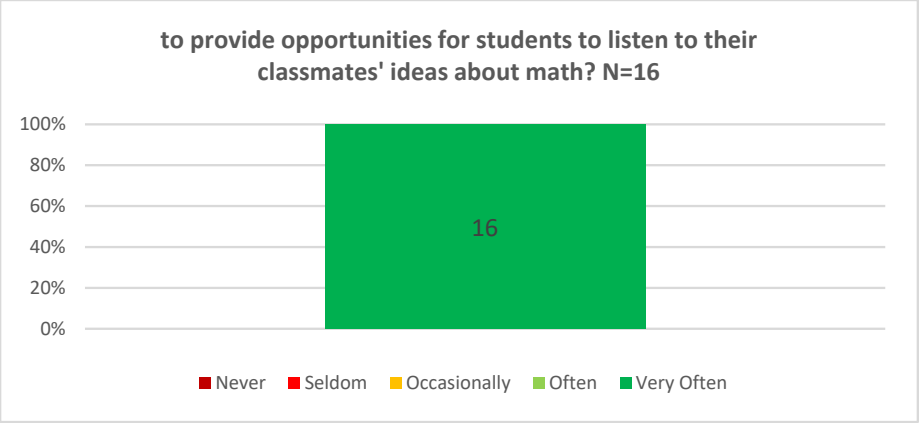
Participants in year two also indicated a solid tendency to allow group work in math with nearly four-fifths (22/79%) indicating they would often or very often do so. Another five (18%) would occasionally and one (4%) who would seldom do so.

Q21) to ask students to work together to solve math problems?



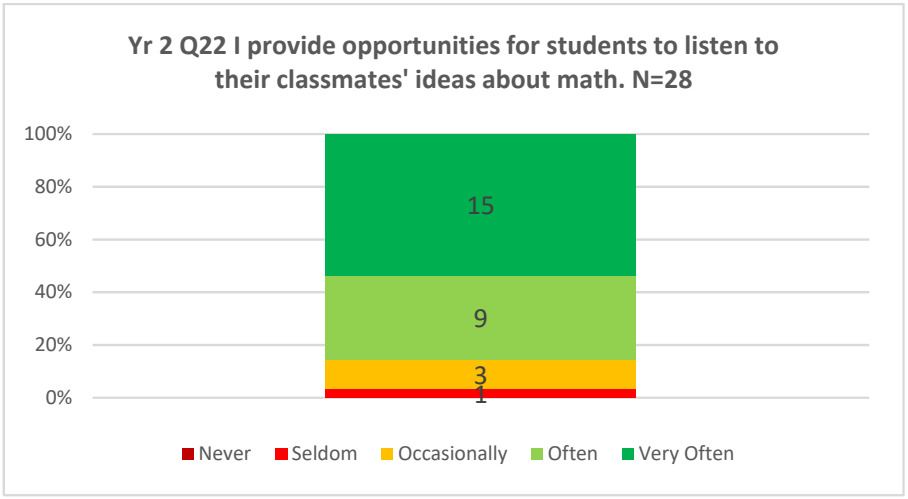
Providing opportunities for students to voice their position and ideas about various concepts is a critical aspect of supporting their participation and engagement in the classroom. Along this line is ensuring that teachers offer the opportunity to state their thinking but also to encourage other students to listen while this process takes place. Such a practice can help reduce shyness or feelings of ignorance surrounding concepts of which they may be unsure. A total majority (16/100%) indicated they very often engage in this practice.

Q22) to provide opportunities for students to listen to their classmates



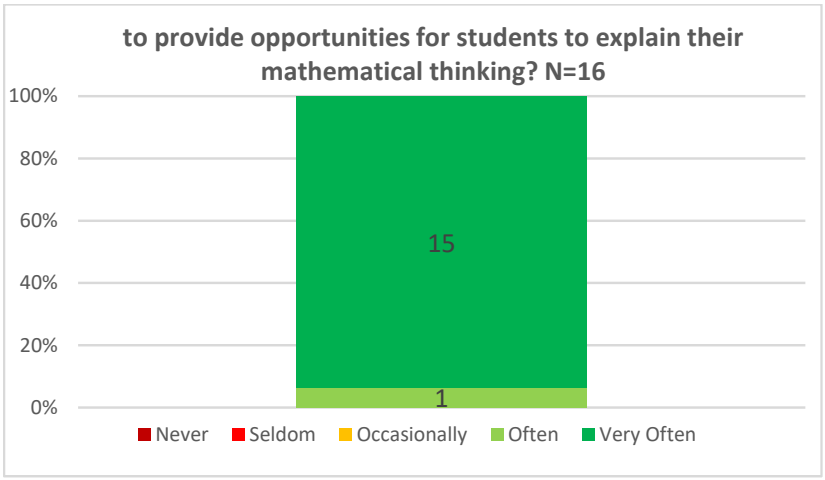
Participants in year two also showed a tendency to often or very often (24/86%) provide opportunities for students to listen to classmates' ideas about math, with three (11%) occasionally doing this, and the remaining one (4%) seldom providing this opportunity.

Q22) I provide opportunities for students to listen to their classmates' ideas about math.



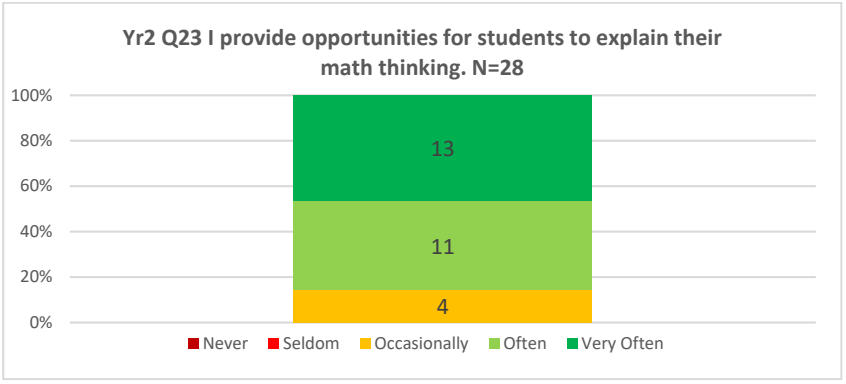
The next query, parallel to the previous, asked the likelihood of a teacher offering the opportunity for students to explain their mathematical thinking. Here too a complete majority (16/100%) indicated they would either often or very often follow this practice.

Q23) to provide opportunities for students to explain their mathematical thinking?



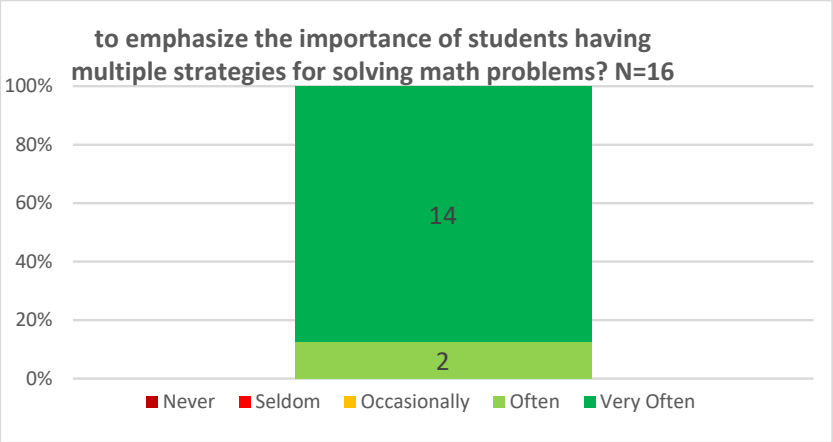
A solid majority (24/86%) of year two participants noted they would provide these opportunities, while the remaining four (14%) selected occasionally.

Q23 I provide opportunities for students to explain their math thinking.



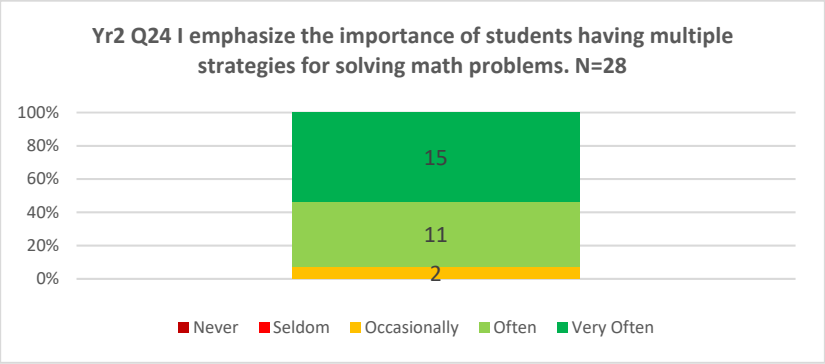
Developing a diverse toolkit for problem solving provides an individual with a multitude of resources. This strategy is important in math as well as all other fields. The following asked teachers how likely they would be in encouraging students to develop multiple strategies for solving math problems. In year one, once more a full majority (16/100%) indicated they would either often or very often provide such encouragement to their students.

Q24) to emphasize the importance of students having multiple strategies for solving math problems?



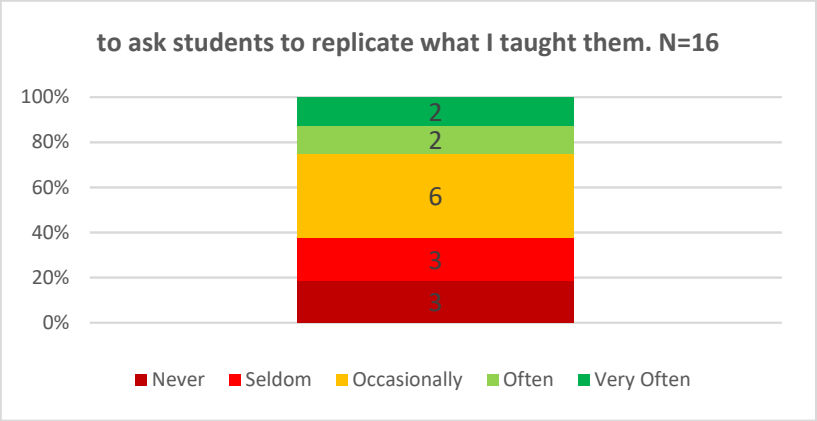
The year two results are nearly as robust as seen in year one in that a solid majority (26/93%) indicated they would often or very often encourage student develop their problem-solving toolkit while the remaining two (7%) would occasionally do so.

Q24) I emphasize the importance of students having multiple strategies for solving math problems.



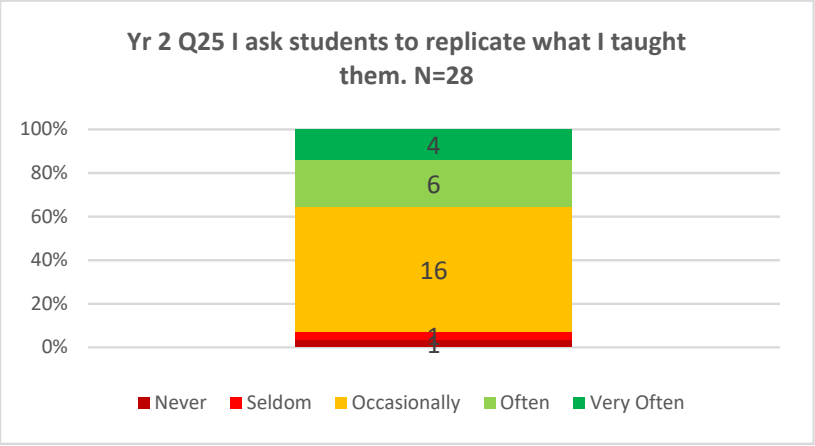
The next query prompted educators on the likelihood of whether they would ask students to replicate what the teacher had taught them. As one of the goals of the workshops had been to have teachers encourage students to develop their thinking and problem-solving skills about math and not just parrot classroom lessons. This question produced a mixed set of results for first year participants in that six (38%) would be unlikely or less likely to do so, with another six (38%) indicating a neutral position, and the remaining four (25%) likely or very likely to do so.

Q25) to ask students to replicate what you taught them?



Year two participants had not yet had the benefit of full engagement with the Mathematical Mindsets professional development, so it is not surprising that a majority of them (16/57%) chose occasionally, another ten (36%) chose often or very often, and one each (4%) would seldom or never make this ask.

Q25) I ask students to replicate what I taught them.



During years one and two, the survey prompted teachers to pronounce their comfort level with and knowledge about math. In response to question 26 (on their comfort level), a large majority (14/88%) of year one teachers indicated either a high or very high level of comfort with the remaining two indicating either a low or very low level of comfort (2/12%). For year two, the base assessment on the same query shows three-quarters (21/75%) indicated a high or very high level of comfort, with the remaining quarter (7/25%) reporting a medium level.

Regarding their knowledge level, a majority of first year respondents (14/88%) indicated a high or very level of knowledge, with the remaining two (2/12%) who chose either low or very low levels. For year two, roughly two-thirds of respondents (18/64%) indicated they had a high or very high level of knowledge regarding mathematics, with the roughly remaining third (10/36%) selecting a medium level of knowledge.

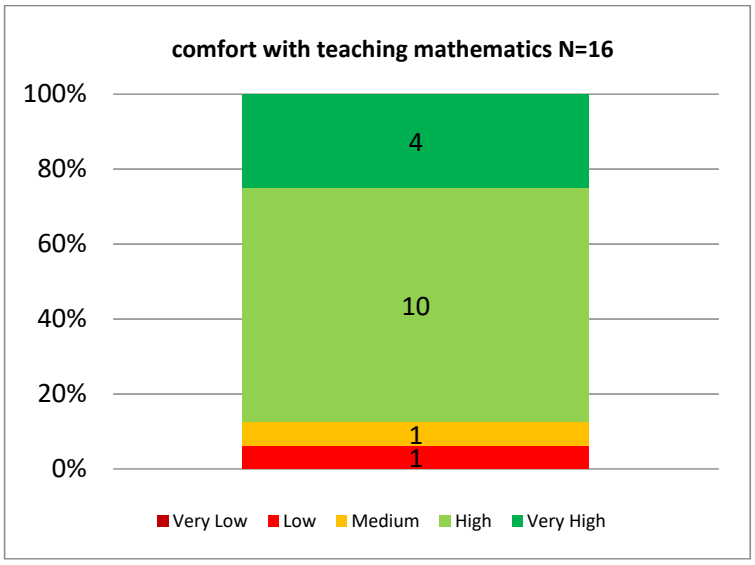
Whereas year two respondents simply answered the prompt as posed, both of the first year queries had the following framing statement:

Thinking about your participation in the Mathematical Mindsets teacher workshops, what has been the effect of that participation on:

- **your comfort level with mathematics**
- **your knowledge level of mathematical content**

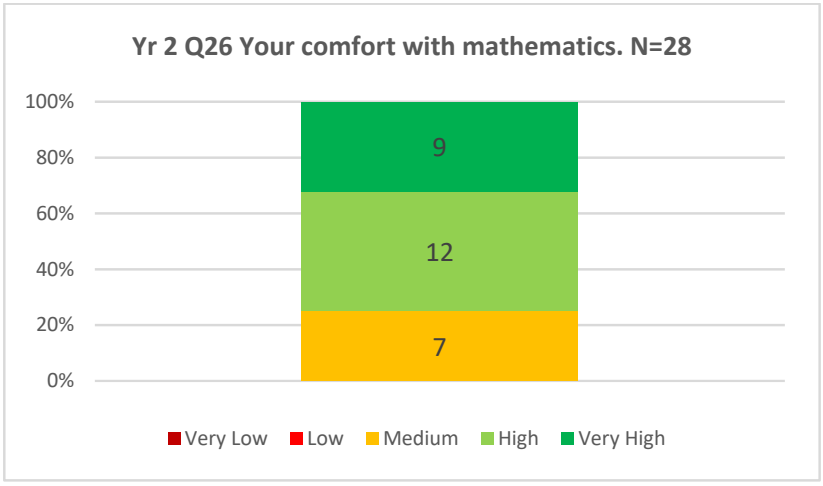
If a person is not comfortable with dealing with math, they often simply withdraw and shut down, feeling like they do not get it. Such a perspective can be particularly problematic if that person is an elementary teacher who is responsible for instructing young children. If the educator downplays math or exhibits discomfort with the discipline, children can sense this and, in turn, run the risk of developing a similar attitude. For the majority of year one participants (14/88%), this apparently is not the case, as they indicated their comfort level as high or very high. One each (7%) noted a medium or low level.

Q26) your comfort level with teaching mathematics



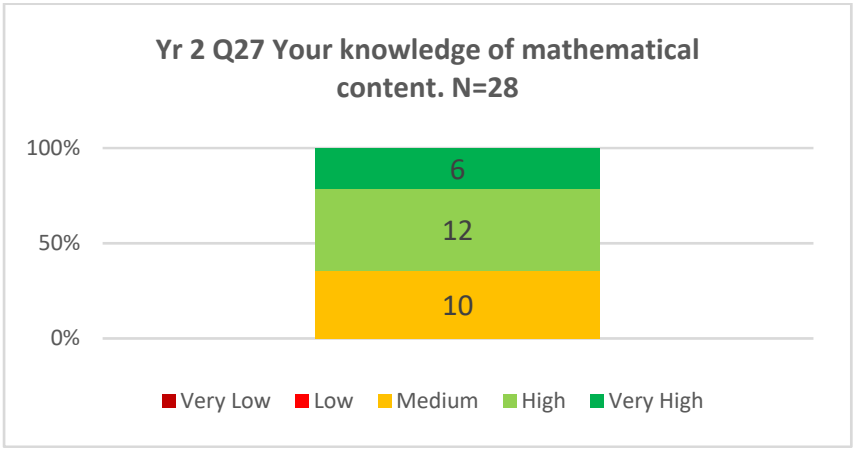
Of the year two participants, three-quarters (21/75%) noted a high or very high comfort level with math, while the remaining quarter (7/25%) selected medium as their level of comfort.

Q26) Your comfort with teaching mathematics.



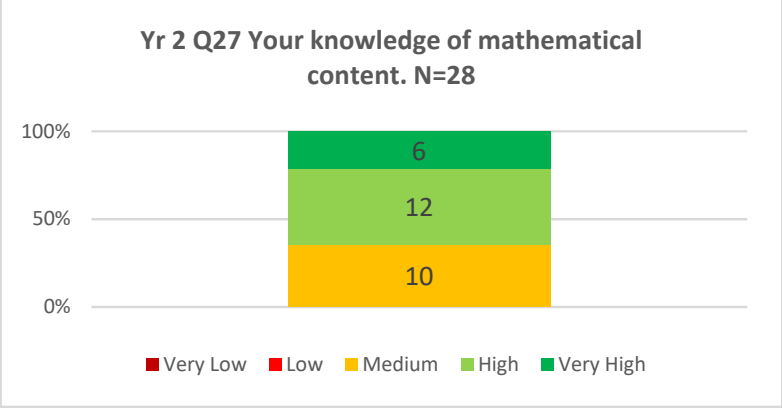
Having a solid foundation of its attendant knowledge is critical for success and impact in any field. Having knowledge in mathematics and especially the pedagogy of mathematics for educators is especially critical so they can expose students to the power and beauty of the discipline. According to the responses in year one a significant majority (14/88%) of participant teachers felt they possessed high or very high levels of knowledge of mathematical content, with the remaining two (13%) indicating they possessed a medium level of knowledge. These educators had already had the benefit of participation in the professional development when they completed the survey.

Q27) your knowledge of mathematical content?



For year two, the proportion who felt they had a high or very high level of knowledge of mathematical content reached nearly two-thirds (18/64%) with the remainder (10/36%) indicating a medium level of knowledge. Of this second year group, of course, not all had yet received the benefit of participation in the professional development opportunities. Nonetheless, a solid majority (18/64%) thought they possessed a high or very high level of knowledge, with the remainder (10/36%) indicating a medium level.

Q27) Your knowledge of mathematical content.



For the following two questions, the survey prompted teachers to indicate what percentage of classroom time they devoted to the various selections. First year respondents provided estimates of time allotment for both before and after their participation in the workshops. For the second year, the survey requested participants designate in what grade group they taught, a request not made of first year participants, hence the breakout by grades 1-2 and 3-5. Mean percentages appear in each of the following three tables. Note that the brackets () indicate a negative change.

Please note that the remainder of the questions from year one and year two now diverge based on the query sequence structures of the surveys.

Year 1: Q28) Before participating in the Mathematical Mindsets teacher workshops, what percentage of time did your students engage in:

Activity	Mean %
Whole class mathematical discussion	18.34
Small group discussion	25.31
Direct instruction	25.63
Independent work time	27
Other	20

Year 1: Q 29) After participating in the Mathematical Mindsets teacher workshops, what percentage of time did your students engage in:

Activity	Mean %
Whole class mathematical discussion	21.88
Small group discussion	28.44
Direct instruction	18.75
Independent work time	27.67
Other	23.33

For the time allotments in the mean percentages devoted to each of the activities noted, the following table provides the difference between years one and two.

Activity	Difference of Mean % between Yrs. 1 & 2
Whole class mathematical discussion	+ 3.54%
Small group discussion	+ 3.13%
Direct instruction	(6.88%)
Independent work time	+.67%
Other	+ 3.33

Year 2: Q28) In a typical math lesson, what percentage of time do your students engage in:

Activity	Grades 1-2 Mean %	Grades 3-5 Mean %
Whole class mathematical discussion	25.83	32.1
Small group discussion	33.57	37.72
Direct instruction	23.75	30.22
Independent work time	28.46	35.45
Other	0	0

For question 30, year one respondents provided the number of lessons from the Mathematical Mindsets website they had completed. Those numbers per grade level appear in the following table. While six participants completed all six lessons, another four completed zero, with a scattering of completers across the other options.

Year 1: Q30) Of the six lessons accessible on the Mathematical Mindsets website, how many have you completed?

Number	Count
0	4
1	1
2	3
3	2
4	0
5	0
6	6

The following question requested year one participants respond to whether or not had started to use/refer to the resources available through the you.cubed.org website. Stanford University hosts the website, which provides numerous resources available to the public and educators who want to explore the creative dimensions of math and the expansion of knowledge engagement with this field can provide. Jo Boaler is a founder and featured member of the site's advisory team.

Year 1: Q31) Have you started to use/refer to the resources available through the youcubed.org website for your teaching?

Response	Count
Yes	14
No	2

The next question served as a follow-up to the year one Q31 that if they had answered yes, the survey requested they briefly describe how they had started to use those resources. Not all participants responded and what follows provides some representative samples.

Year 1: Q32) If yes, how have you started to use/refer to those resources?

- *I have looked at the resources for lessons/problems that might be engaging especially when beginning a new unit.*
- *I have used the math activities we did in training with my students.*
- *I introduce the activities and allow my students to work as a group and I observe how each member . . . participates.*
- *I have used a few of the youcubed lessons in my class.*

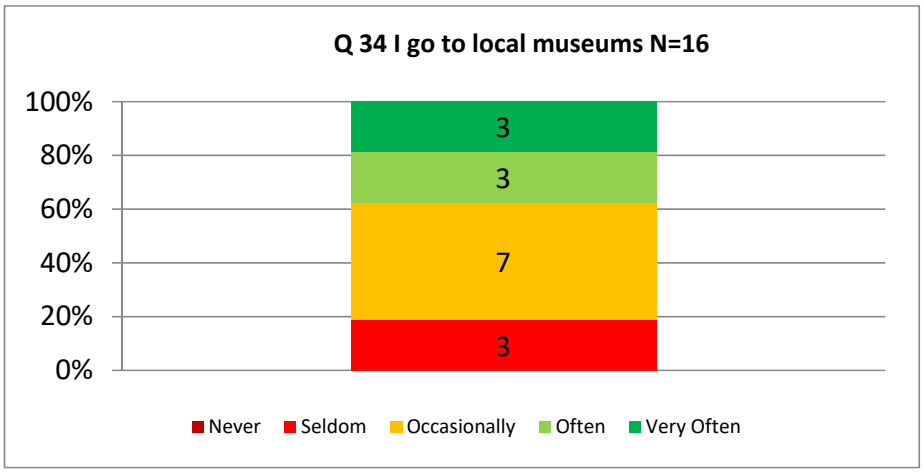
Getting an overall impression of teachers experiences from participation in the workshop served as the focus of the following question. A few illustrative examples follows.

Year 1: Q33) Please describe in your own word what participating in the Mathematical Mindset workshops has meant to you.

- *I've been able to realize the importance of allowing students to struggle, share, and discuss math.*
- *I understand more that math is not just "2+2=4." It is expanding knowledge, using open-ended questions and answers, [and] exploring learning. I have appreciated this experience.*
- *This has opened my eyes to understand the math growth mindset.*
- *This truly supported me in understanding my students better and approach math differently.*

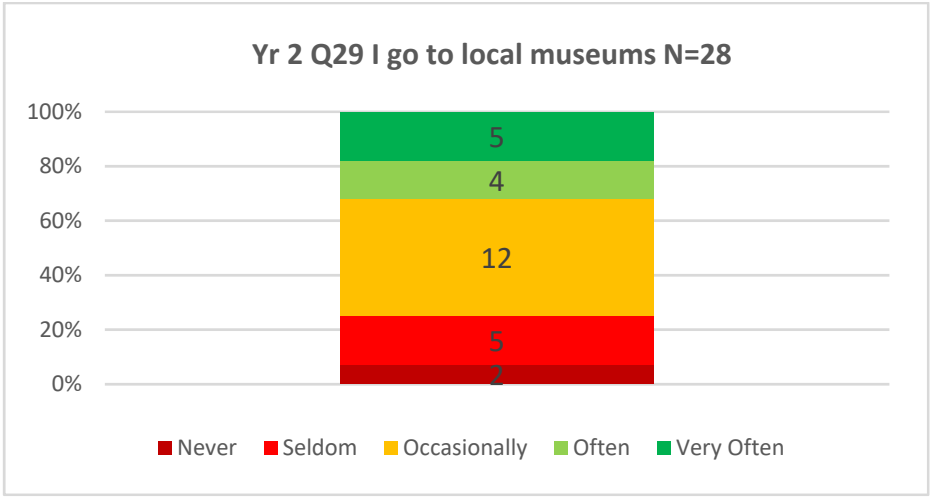
Taking advantage of various cultural resources suggests that a person is interested in expanding their interests and knowledge related to the myriad things that people have done and do. A central resource is that which museums provide. Residents in the immediate Albuquerque area have access to several. Among these options, include the International Balloon Museum, the Albuquerque Museum, the New Mexico Natural History Museum, Explora Children's Museum, the National Nuclear Museum, UNM Maxwell Museum of Anthropology, and a rather exotic one, the American International Rattlesnake Museum. Six (38%) year one participants indicated that they often or very often visit museums and seven (44%) noted they occasionally do, while the remaining three (19%) selected seldom.

Q34) I go to local museums



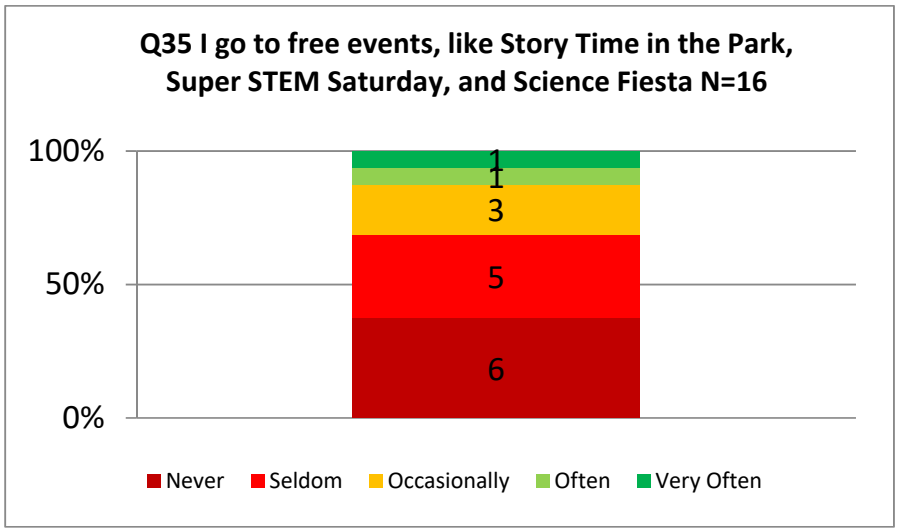
Of year two participants, nine (32%) indicated they often or very often go; another twelve (43%) occasionally do so; and the remaining seven (25%) seldom or never did.

Q29) I go to local museums.

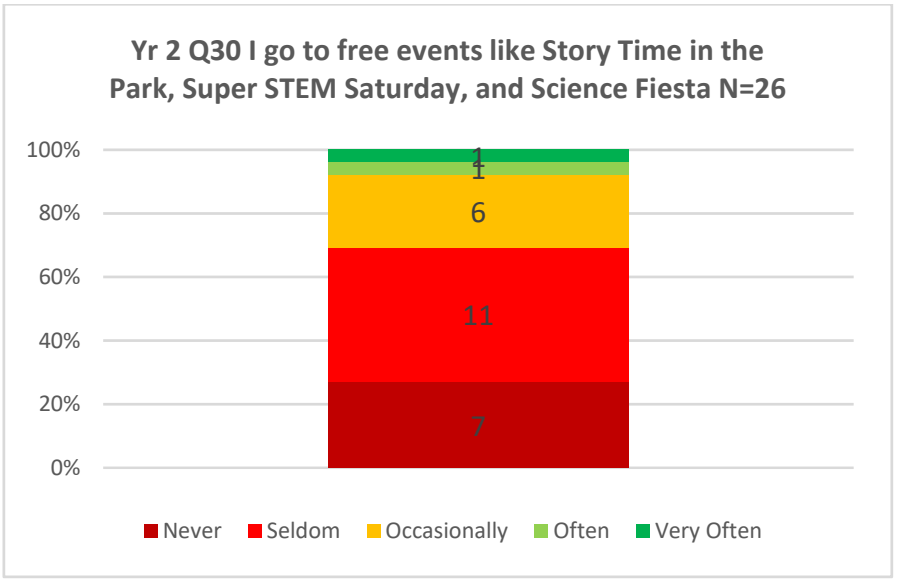


Attendance at free events, such as Story Time in the Park, Super Stem Saturdays, and Science Fiesta evidently do not have the same type of draw for teachers as museums. As shown in both the year one and year two graphs, majorities (Yr1 11/69%) (Yr2 18/64%) indicated they seldom or never went; while much smaller numbers (Yr1 3/19%) (Yr 6/23%) chose occasionally. Only one (Yr1 6%) (Yr2 4%) selected often or very often for each year.

Year 1: Q35) I go to free events, like Story Time in the Park, Super STEM Saturdays, and Science Fiesta.

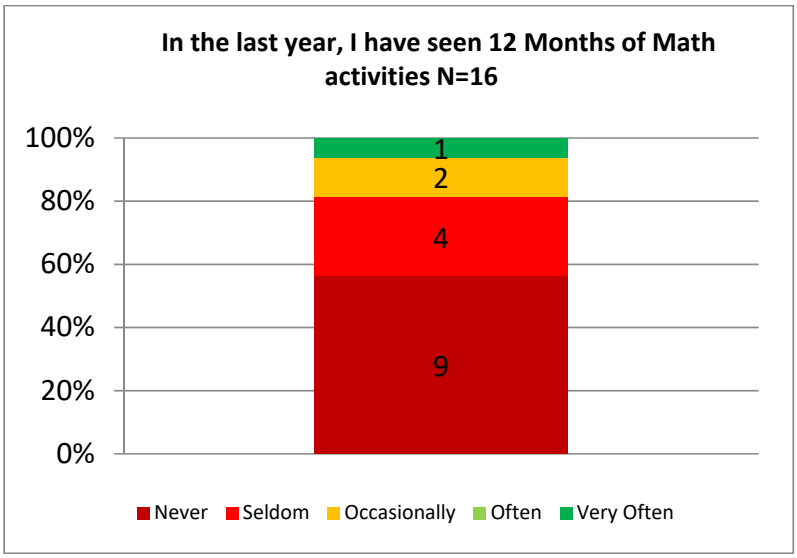


Year 2: Q30) I go to free events, like Story Time in the Park, Super STEM Saturdays, and Science Fiesta.



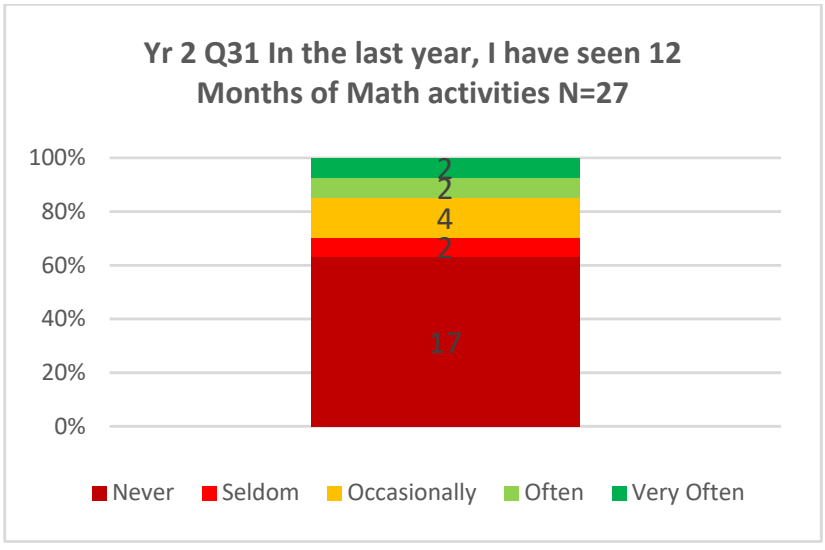
The 12 Months of Math resource that the Explora Museum provides through its website offers a spotlight on various careers that routinely use math. Each month highlighted careers that included scientists, medical professionals, and engineers, among others. The web resource exposed visitors (especially children, but also parents and teachers engaged in the FACESS project) to professionals they may not be familiar, and to demystify what these people do. Unfortunately, participating teachers typically did not engage the resource as noted in year one when a significant majority (13/81%) indicated they seldom or never seen 12 Month of Math Activities, and another two (13%) seldom did. Only one (6%) often saw such activities.

Year 1: Q36) In the last year, I have seen 12 Months of Math activities.



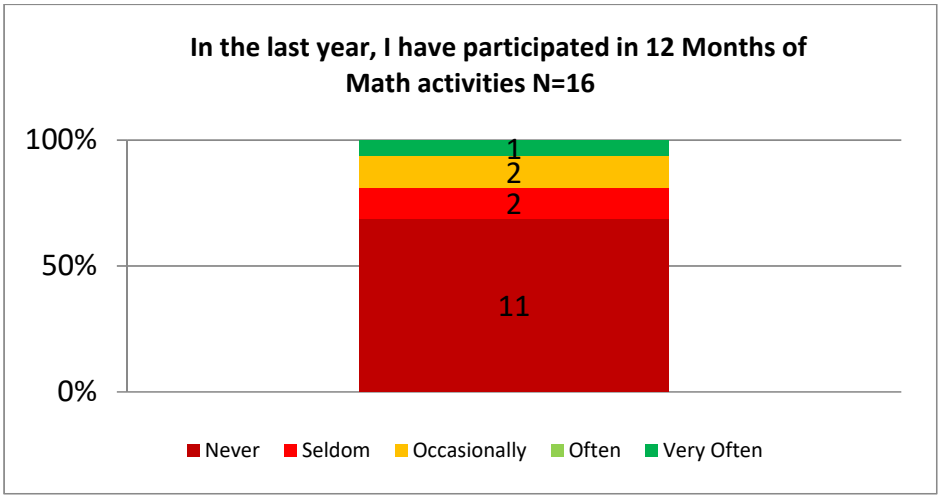
In year 2, a similar pattern appears with a majority (19/70%) indicating they seldom or never saw these activities, while another four (15%) occasionally did, and the remaining two each (7%) often or very often saw these activities.

Year 2: Q31) In the last year, I have seen 12 Months of Math activities.

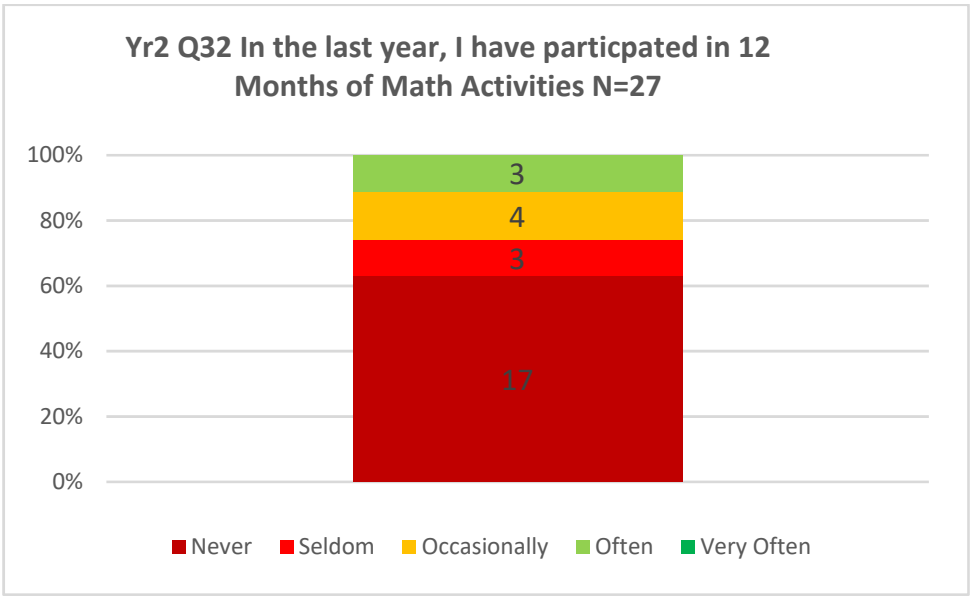


It is one thing to see the 12 Months of Math activities and another to participate. Once again, the pattern of non-participation proved dominant. During year one, more than four-fifths (13/81%) of the teachers indicated they seldom or never participated, and another two (13%) did so only occasionally and one (6%) often did.

Q37) In the last year, I have participated in 12 Months of Math activities.



For year two, nearly three-quarters (20/74%) never or seldom participated, while four (15%) occasionally did, and three (11%) often did.



The last question addressed what grade group the teachers taught. While the survey did not ask the question above during year 1, the surveys served as a proxy to provide an aggregate tally for the two schools that participated. These figures appear in the first table below and the year two aggregate count for the three participating schools appears in the following table.

Q33) In what group of grades do you teach? (Asked only in year 2.)

Year 1 – Two Schools

Grade Group	Count
K-2	8
3-5	8
Total	16

Year 2 – Three Schools

Grade Group	Count
K-2	16
3-5	13
Total	29

Parent Findings

After their last workshop in spring 2019, parents participating in FACESS completed a survey to collect their impressions of their experiences. Comprised of thirty-one questions, the survey queried them on:

- What participation in the Mathematical Mindset parent workshops had helped them to do across various domains?
- What were their current trepidations related to engagement with their children despite their participation in the workshops?
- After participating in the parent workshops, how often did they engage with their children over various aspects of how math applies in everyday life?
- After participating in the parent workshops, what was their level of agency in discussing math-related matters with their children?
- Various questions related to their access to workshop-related resources, visits to free events or museums, and their participation in or observation of public events related to "12 Months of Math."
- The last three questions ask the grade(s) of their child(ren), the parents' highest level of educational attainment, and what languages were spoken in the home.

What follows as shown in the responses provided, most participating parents felt more empowered about math, they were less intimidated with math, could now understand their child's math schoolwork, and they had changed their thinking about math to embrace a growth perspective about the discipline.

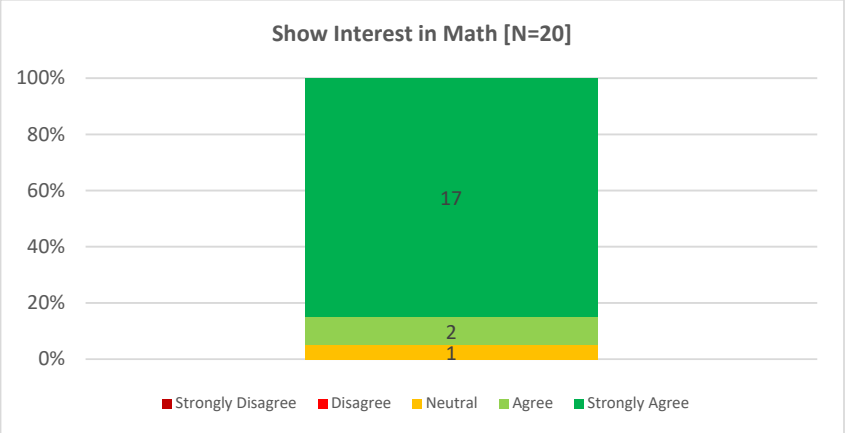
The following provides a discussion of these findings from the first year.

The first nine questions built on the following framing prompt:

Participation in the Mathematical Mindsets parent workshop have helped me to:

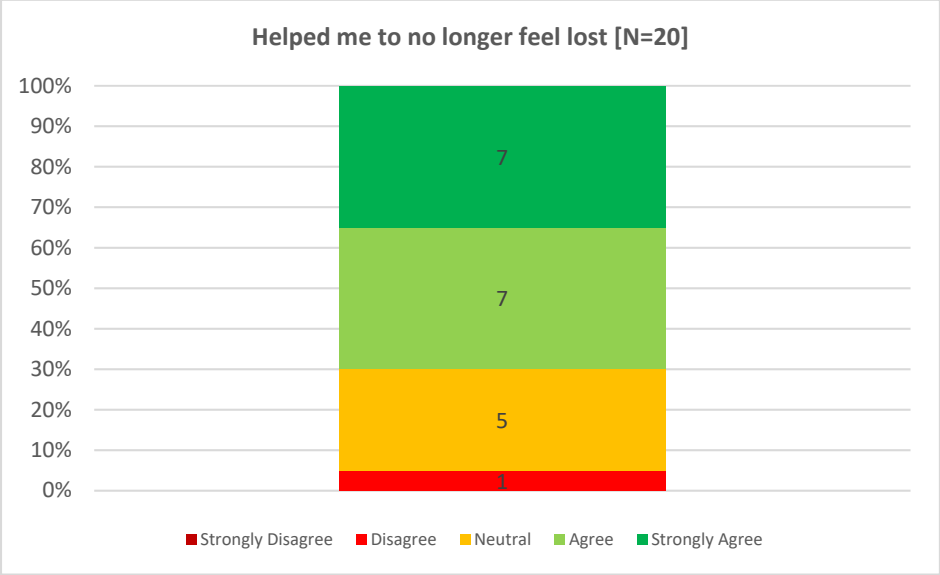
This question sought to establish whether parents understood the critical role they played for developing their child's level of engagement through modeling an interest in math. Out of the twenty parents who answer this, nineteen (95%) indicated they either agreed or strongly agreed and one (5%) gave a neutral response.

Q1) understand I help my child when I show interest in what they are doing in math.



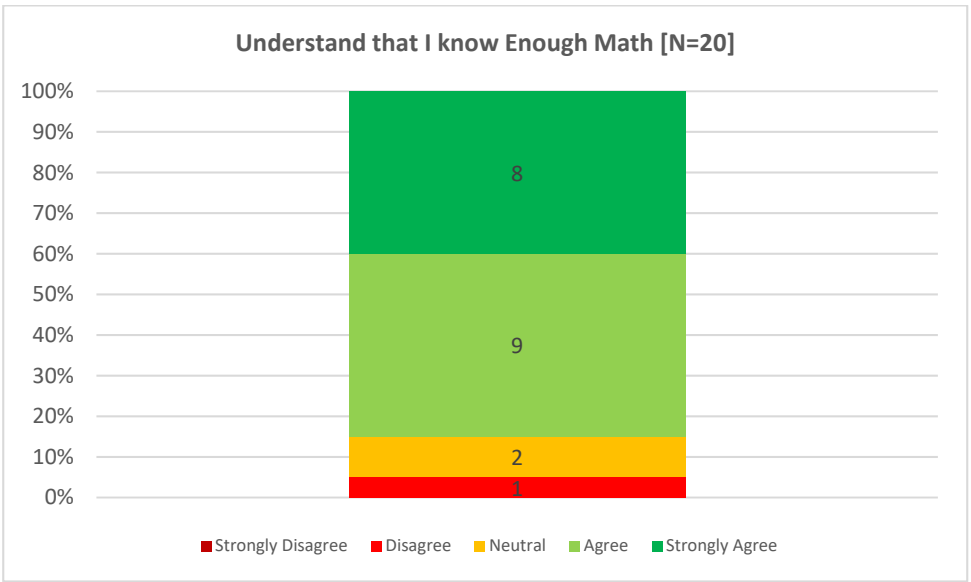
The next prompt sought to determine whether parents felt empowered through their participation in the Mathematical Mindset workshops and no longer felt lost trying to help their children with math. Fourteen (70%) either agreed or disagreed. Another quarter (5/25%) were neutral and 1 (5%) disagreed.

Q2) no longer feel lost trying to help my child with math.



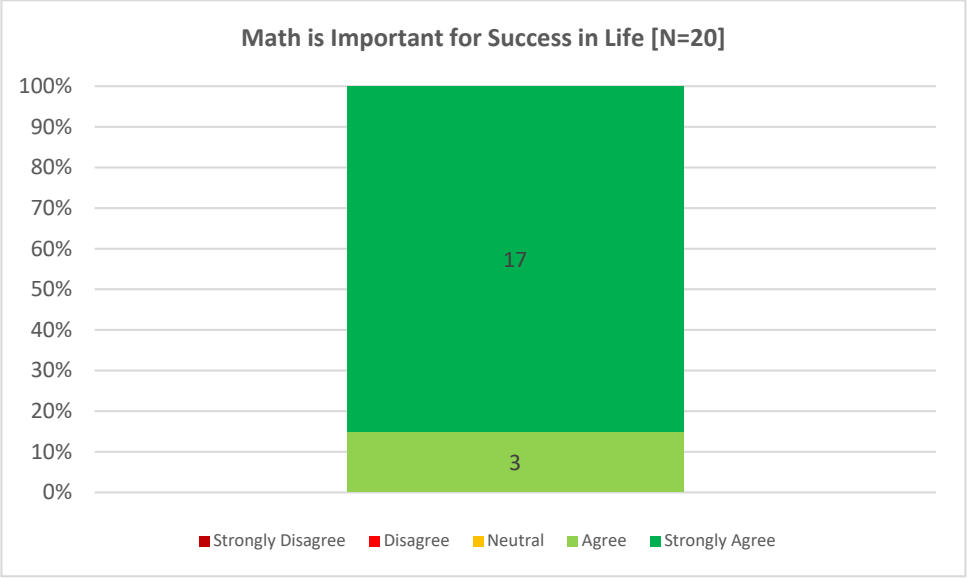
Building on the sense of empowerment queried in the previous question, the next prompt asked whether they had learned enough through their participation to help their children. Seventeen (85%) either agreed or strongly agreed they now understood enough math to assist their child. Another two (10% were neutral and one (5%) disagreed.

Q3) understand that I know enough math to help my child.



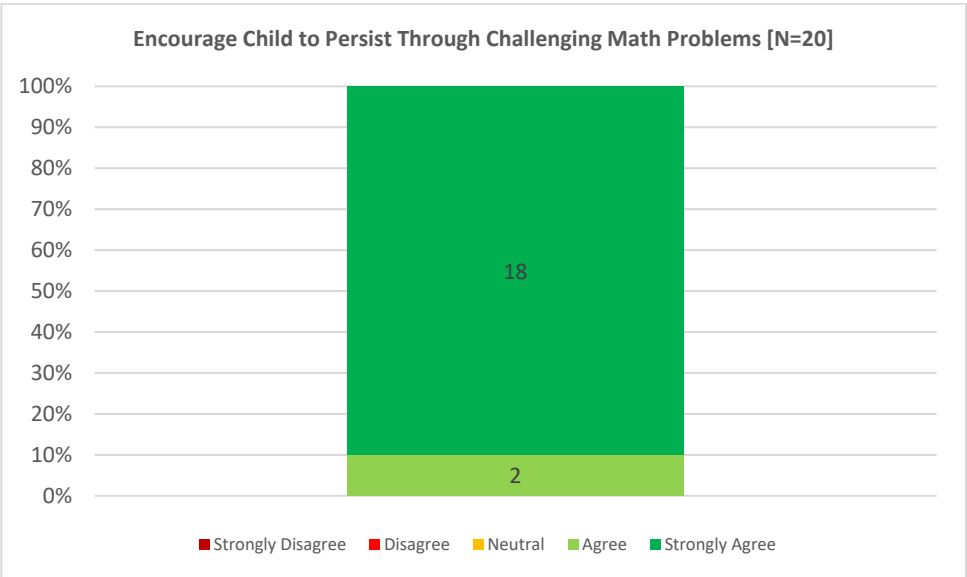
The next question probed whether parents understood that math (and a certain level of mastery in the field) was important for success for life. Participation in the workshops appears to have impressed the respondents sufficiently about the importance of math and success in life that all 20 (100%) either agreed or strongly agreed.

Q4) understand that math is important for success in life.



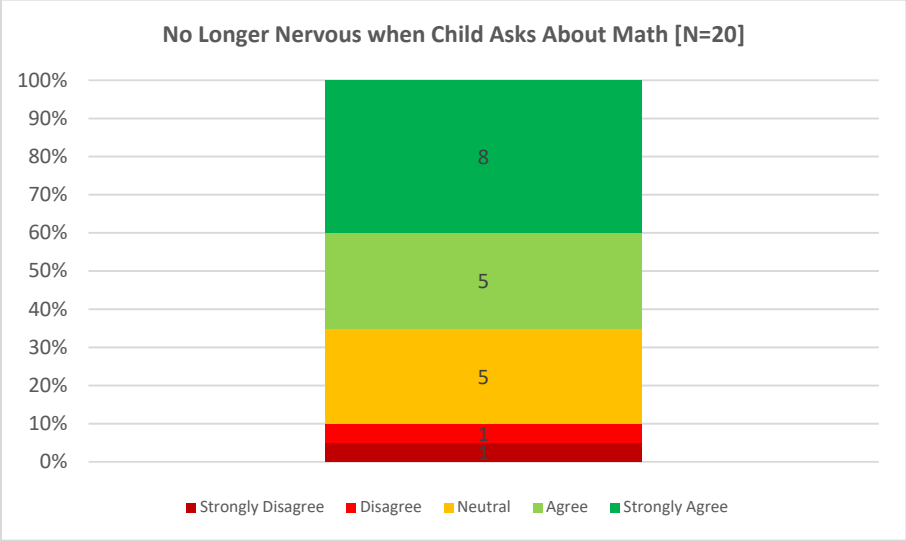
The next in the series wanted to determine whether their participation pushed parents to encourage their child to persist when confronting challenging math problems. Such persistence reflects the concept of a growth mindset that both Dweck and Boaler describe in their writing and can be a critical aspect of successful engagement with math. Here, too, all twenty (100%) of the respondents either agreed or strongly agreed.

Q5) encourage my child to persist through challenging math problems.



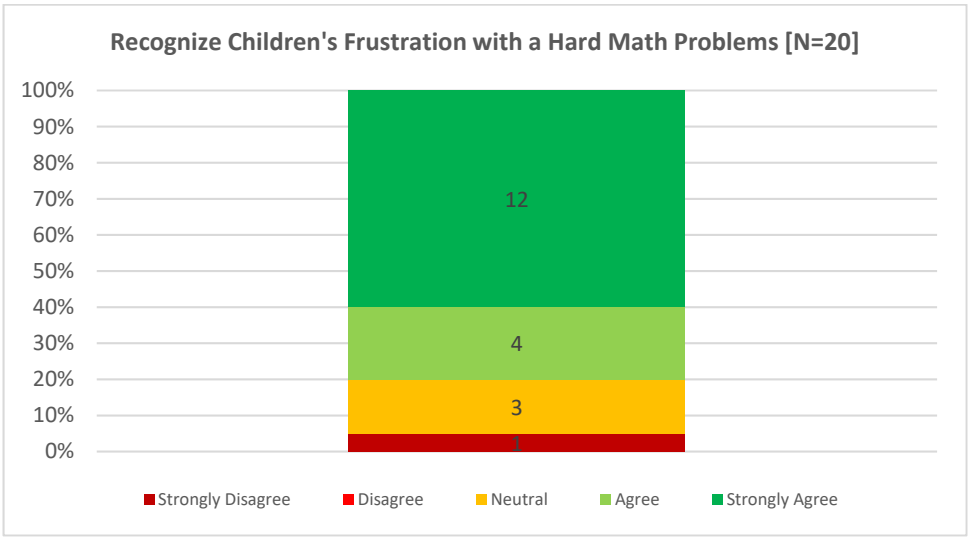
In line with the previous query, the following prompted parents on whether they became anxious when their child asked them about math. While a large majority of thirteen (65%) either agreed or strongly agreed, one-quarter (25%) were neutral and another one (5%) each either disagreed or strongly disagreed.

Q6) no longer get nervous when my child asks me about math.



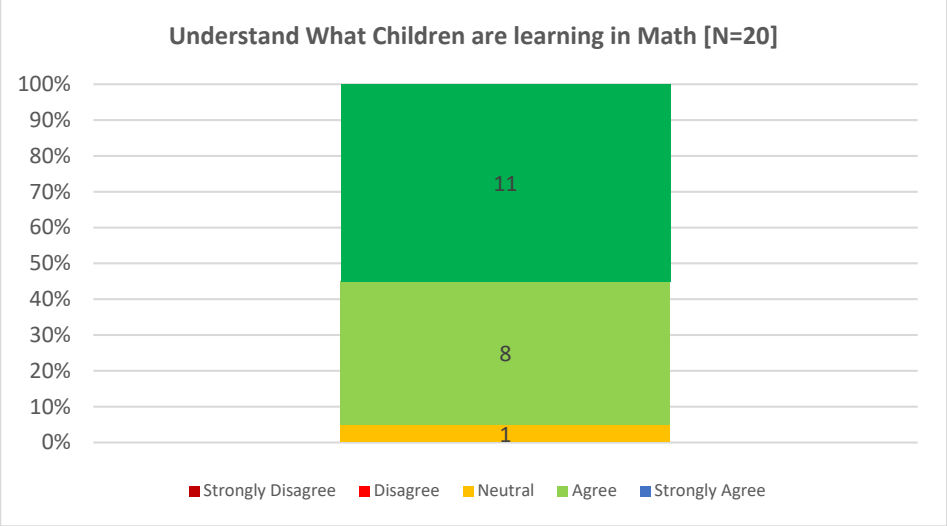
While the previous question noted the parent's anxiety, the next one focused on a child's frustration with math and the importance of the psychological support the child realized through the parent's mere recognition of the child's struggle. Four-fifths of parents (16/80%) either agreed or strongly agreed with this perspective, while three (15%) were neutral and one (5%) strongly disagreed.

Q7) understand that I help my child when all I do is recognize their frustration with a hard math problem.



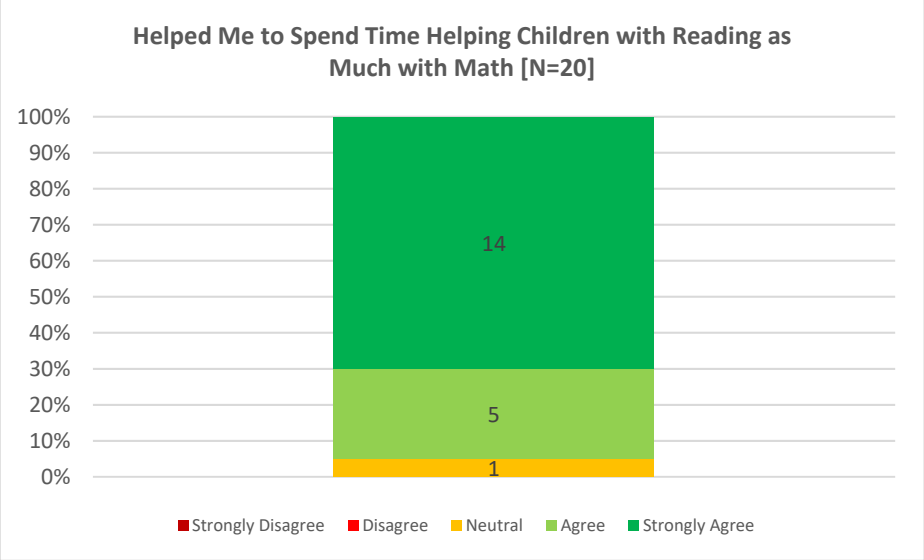
Often parents can be detached from what their child is learning and the following sought to uncover whether the parents from the mindset workshops might be different. A near complete majority (19/95%) of parents agreed or strongly agreed they possessed an understanding of what their children are learning in math and one (5%) remained neutral.

Q8) understand what my child is learning in math.



During these days of school reform much time and energy is directed towards developing skills in reading and math. The next prompt wanted to determine the extent that parents spent as much time helping their children with reading as with math. To that end, here, too, a near total majority (19/95%) either agreed or strongly agreed with the prompt they spent their time helping the learning process with their child between reading and math with one (5%) stating neutrality.

Q9) spend as much time helping my child/children with reading as with math.

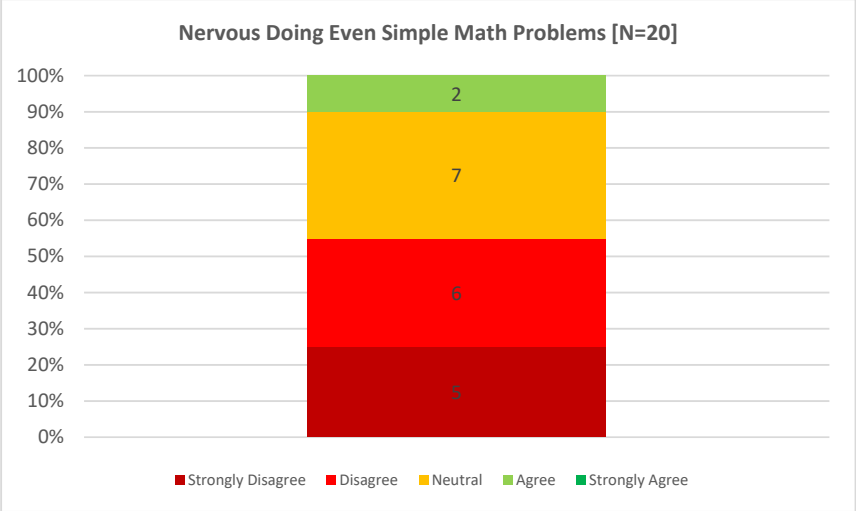


The next set of questions sought to establish in what areas parents continued to have some trepidation in dealing with math whether on a personal level or engaging their children. Three questions used the following framing prompt to help gather this information:

Although I have participated in the Mathematical Mindsets parent workshops, I still:

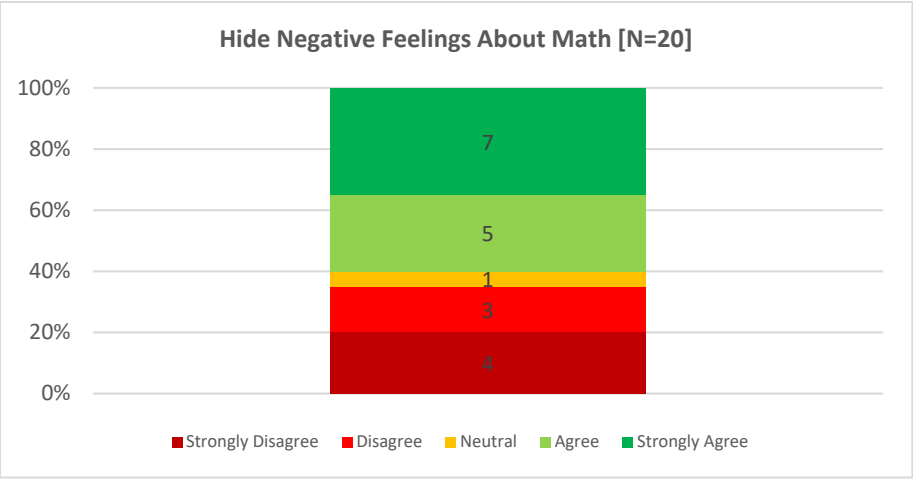
The first of these quizzed parents on being nervous doing simple math problems. More than half (11/55%) either disagreed or strongly disagreed with this probe. This type of response is what the FACESS team would want to see. Although another seven (35%) chose a neutral response and two (10%) agreed.

Q10) get nervous doing simple math problems.



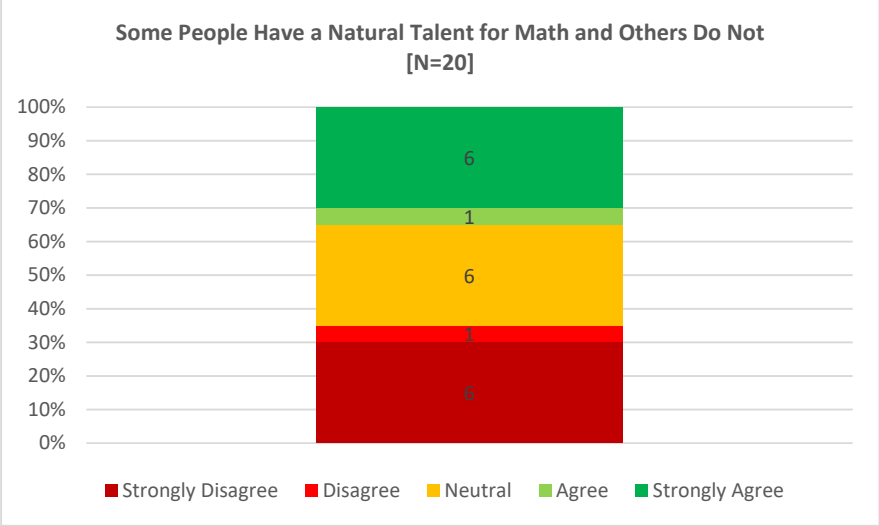
Seeking to determine whether parents had negative feelings toward math, the following prompt shows that twelve (60%) agreed or strongly agreed they continued to hide their negative feeling toward math from their children. Another seven (35%) either disagreed or strongly disagreed and one (5%) was neutral.

Q11) try to hide my negative feelings about math from my child/children.



In an effort to determine whether parents believed that some people were talented in math and others not, the survey included such a query. This belief is contrary to the research both Dweck and Boaler have conducted that shows math talent is not fixed and with adequate effort and inquiry can be strengthened and expanded over time. The responses distributed equally across the options with seven (35%) who agreed or strongly agreed, six (30%) who chose neutral, and the other seven (35%) who disagreed or strongly disagreed.

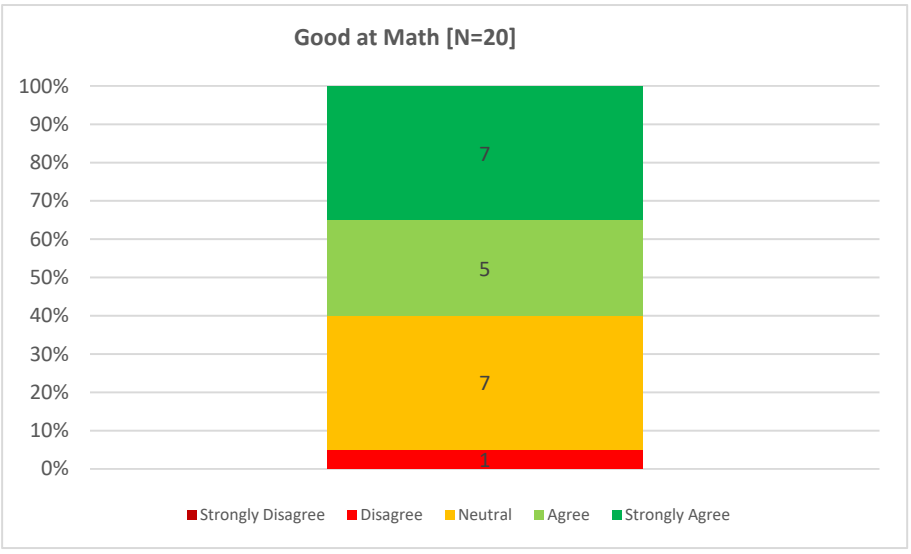
Q12) think some people have a natural talent for math and others do not.



The next query sought to have parents explain the degree to which they thought participation in the Mathematical Mindset workshops helped them to think they were good at math. A solid majority (12/60%) agreed or strongly agreed, another seven (35%) were neutral, while one (5%) disagreed.

Participation in the Mathematical Mindsets parent workshops has helped me to:

Q13) think I'm good at math.

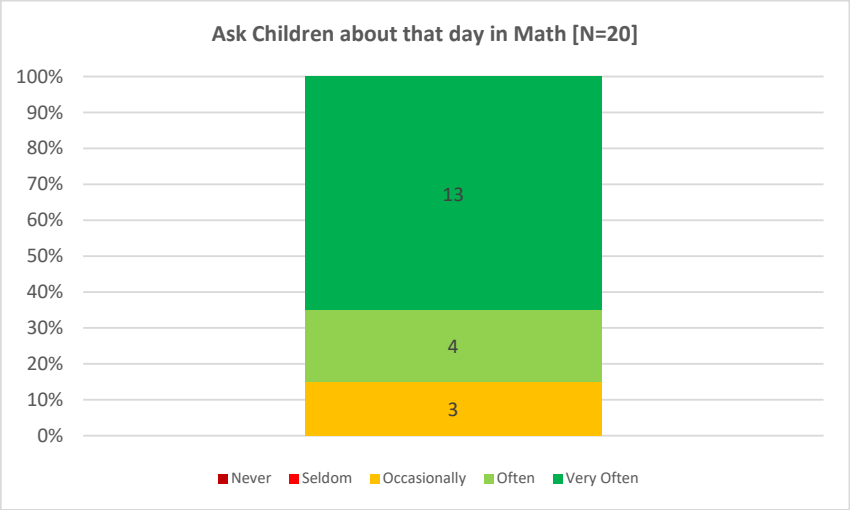


The following three questions sought to get a sense of the frequency parents engaged with their children on different aspects of math and used the following framing prompt:

After participating in the Mathematical Mindsets parent workshops, how often do you:

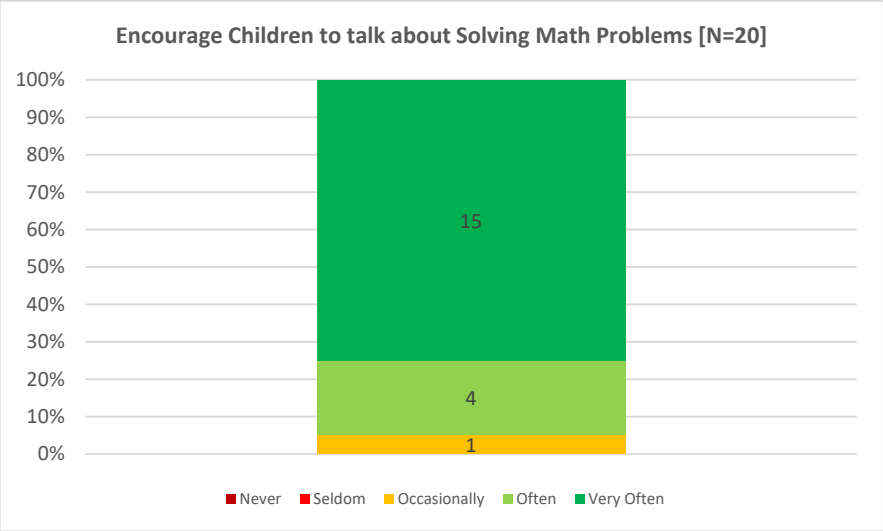
Engaging their child on a daily basis on what she did in math was the focus of the first. A large majority (17/85%) selected often or very often, while another 3 (15%) indicated they did this occasionally.

Q14) ask your child about what he or she did that day in math?



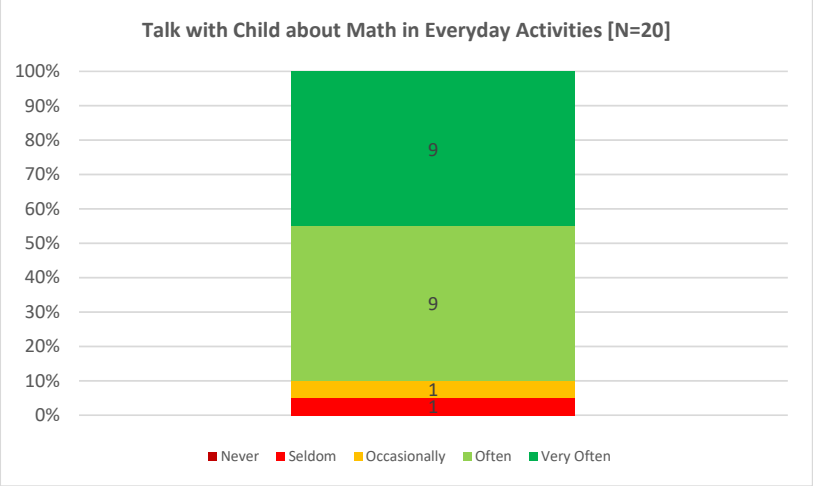
The next sought to uncover how often parent engaged their child to tell them how they solved a math problem. A near complete majority (19/95%) indicated they did this often or very often and one (5%) indicated occasionally.

Q15) encourage your child to tell you how he/she might solve a math problem?



Talking with their child about math in everyday life was the focus off the last of these three prompts. The importance of discussing how math plays out in everyday settings helps to normalize and demystify the field thus reducing the likelihood of developing "math phobia" that could sidetrack them as they move into an adult career. Here again, a strong majority (18/90%) selected often or very often with one (5%) each selected occasionally or seldom.

Q16) talk with your child/children about the math in everyday activities?

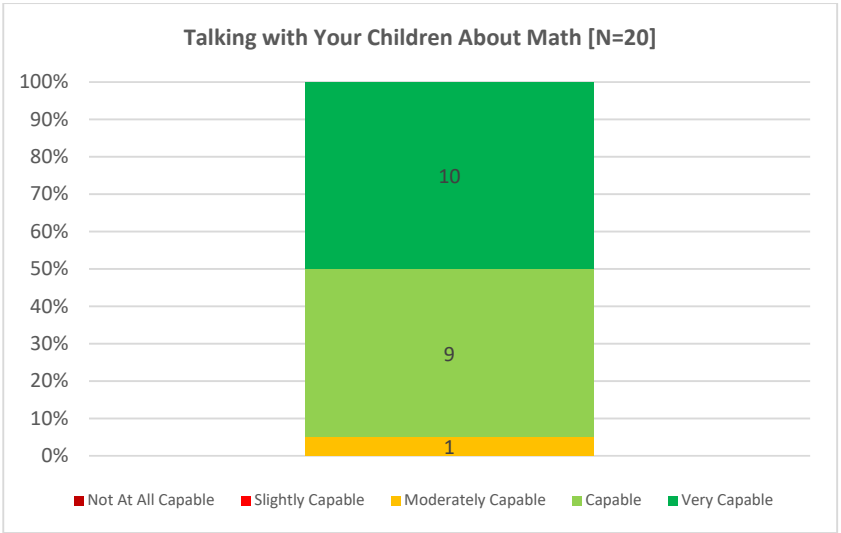


Inquiring about another dimension of parental agency, the following four questions focused on how capable they felt engaging their children on math through using this framing prompt:

After participating in the Mathematical Mindsets parent workshops, how capable do you feel:

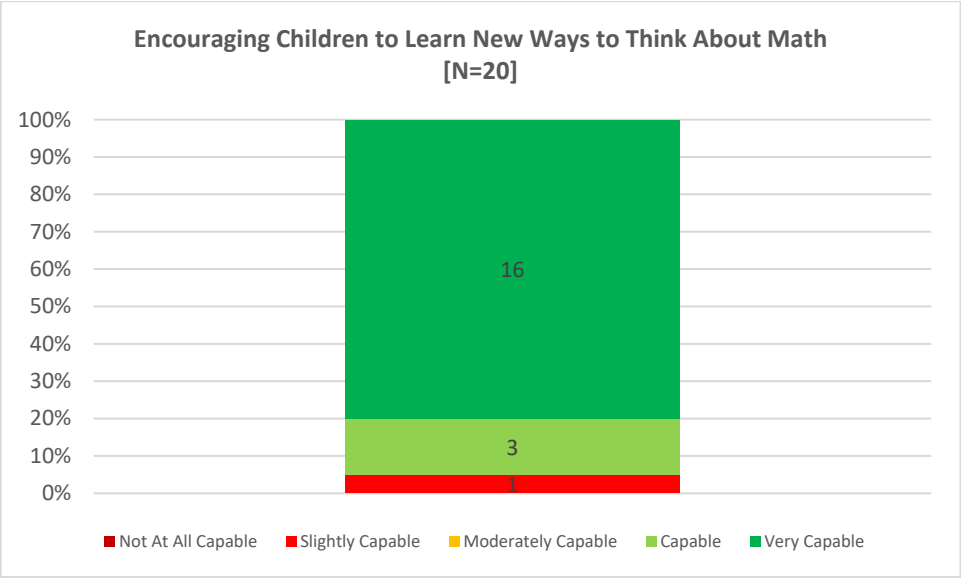
Talking about math with their child was the first in this subset. Parents expressed a high level of agency in that nearly of all them (19/95%) selected capable or very capable and one (5%) chose moderately so.

Q17) talking with your child about math?



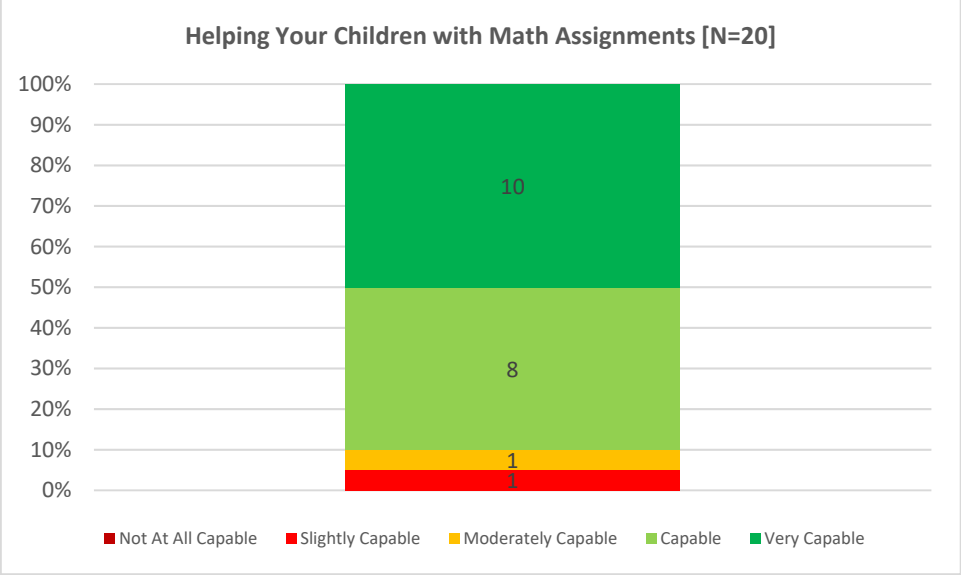
Approaching math problems in different ways is the result of developing a toolbox with various options. This next question sought to uncover how capable parents felt about getting their child to learn new ways to think about math. Nearly of all (19/95%) chose capable or very capable and one (5%) selected slightly so.

Q18) encouraging your child to learn new ways to think about math?



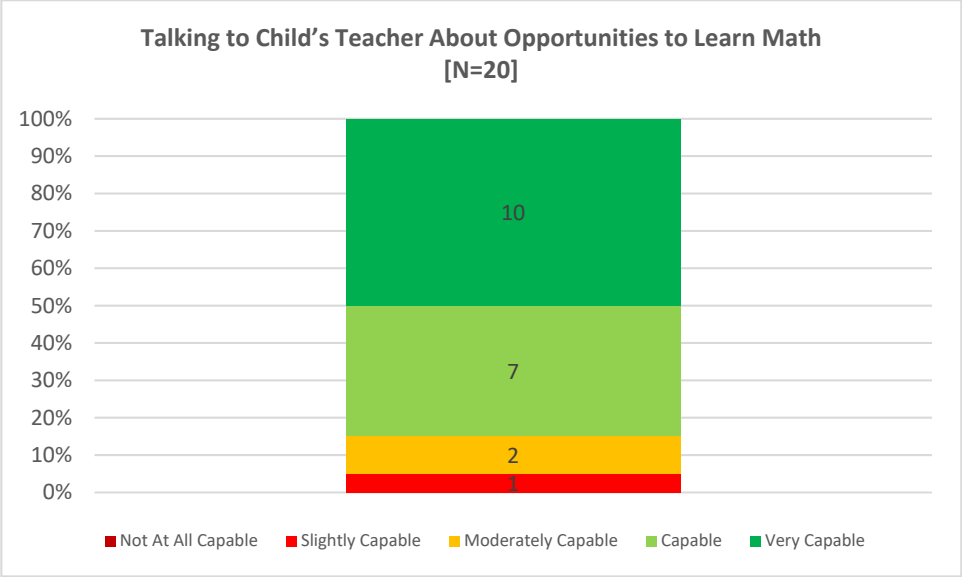
A large majority of parents (18/90%) felt capable or very capable helping their child with math assignments. Another one each (5%) thought of themselves as moderately or slightly so.

Q19) helping your child with math assignments?



Exercising agency in affairs related to a child's education can also be expressed through engaging with the teacher. The next question asked about a parent's capability for doing this and seventeen (85%) felt capable or very capable. Another two (10%) felt moderately so and one (5%) indicated slightly.

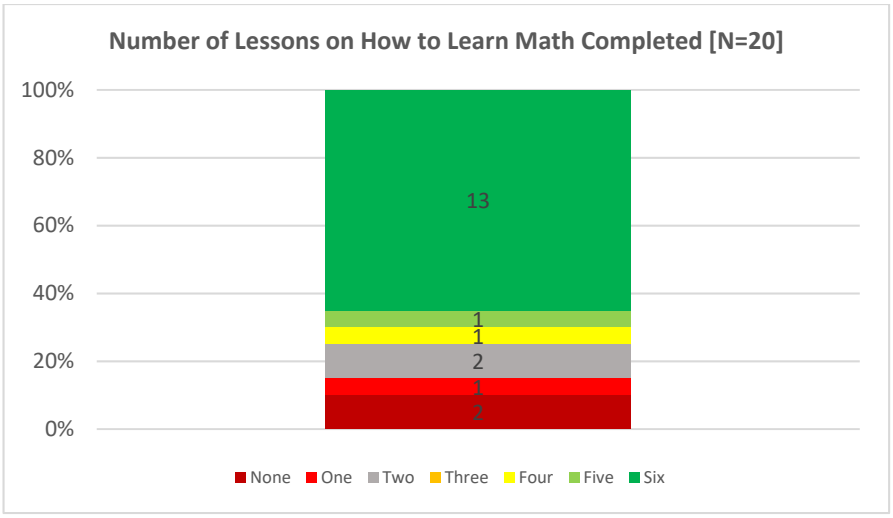
Q20) talking with your child's teacher about your child's opportunities to learn math?



Inquiries about the use of resources related to participation in the Math Mindset workshop served as the focus of the next two questions. The first of these asked parents to note how many of six lessons available on the How to Learn Math website they had completed. Thirteen (65%) completed all six; two (10%) each completed two or none; and another one (5%) each completed 5, 4 or 1 lessons.

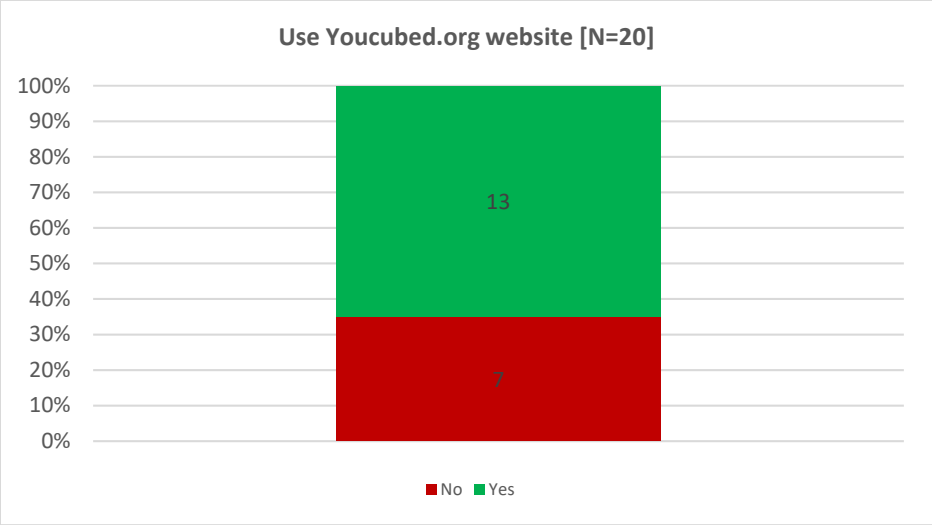
Of the six lessons available on the How to Learn Math website:

Q21) how many have you completed?



Another resource available to workshop participants was the youcubed.org website. Presented as a math resource for everyone, the workshops encouraged parents to access the site. The central goal of the website is "to transform the latest research on math into accessible and practical forms." Jo Boaler, the math educator who provided much of the foundational thinking for the Math Mindset workshops and activities is a major contributor to the site that operates through Stanford University. Two-thirds (65%) of the respondent indicated they had.

Q22) Have you begun to use/refer to any of the resources from the youcubed.org website for working with your child?



The following question served as a follow-up to help identify how parents used the resources they accessed from the you.cubed.org website. Only four parents provided a response and these appear below.

Q23) If yes, how have you begun to use the resources from the youcubed.org website? Please briefly describe below.

- *Explaining different ways to add.*
- *Just what we covered in class.*
- *I and my child watched some of the videos, Also the idea of not focusing on failures because failures in math are indeed good.*
- *Watched the video together.*

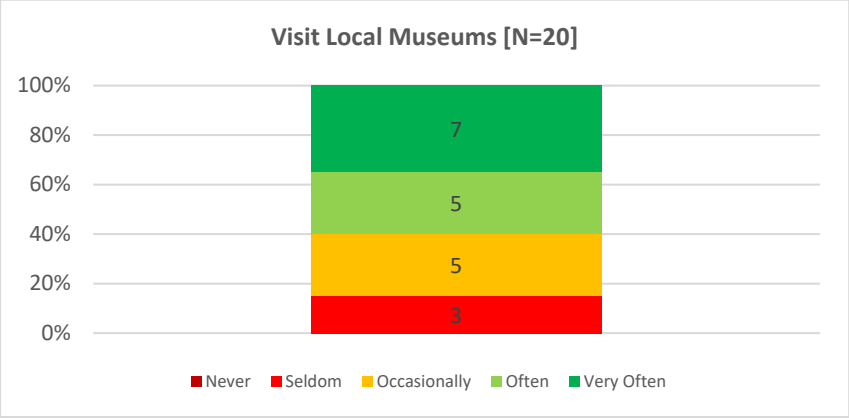
The next query prompted parents to provide a personal testimony of the effect they experiences from participating in the Mathematical Mindsets workshops. Seventeen responded and some illustrative examples follow.

24) Please describe in your own words what participating in the Mathematical Mindsets workshop has meant to you.

- *Participating in the workshops made me feel more confident to support my child in math. It made math less intimidating and that even if I am not an amazing mathematician but I can still support my child.*
- *Ease of stress regarding math and breaking it down in my way.*
- *Just understanding there are lots of different ways to solve a problem.*
- *I have a master's in astronautical engineering so I think about math at one level and this has helped me think with a different mindset. The biggest thing that stuck with me is asking, "How did you come to that answer?"*
- *Mathematical mindset has help me to see math differently. I learn different matters on how to help or understand my child.*
- *It has helped me to better understand what my children are learning.*

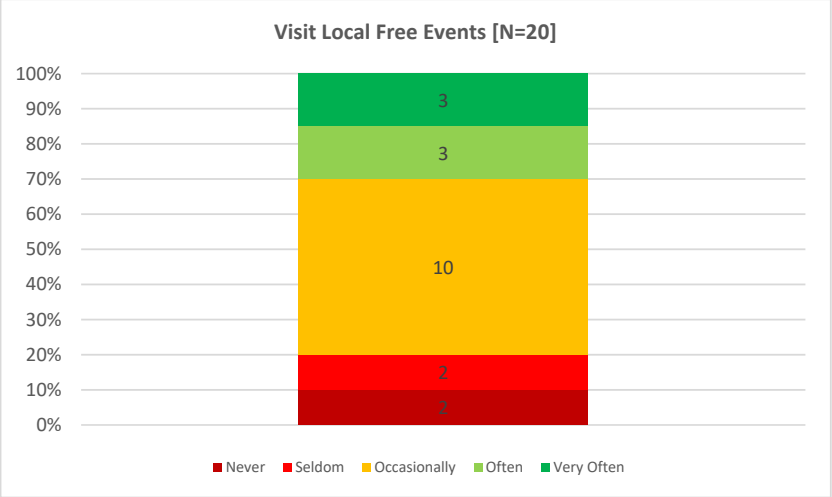
The next several questions sought to uncover the extent to which parents used other cultural resources with their families. The first of these asked about visiting local museums, which provides children exposure to numerous artifacts of history, anthropology or art that helps describe the human experience. A solid majority (12/60%) selected often or very often. Another five (25%) chose occasionally, and three (15%) indicated seldom.

Q25) My family and I go to local museums.



The next prompt focused on whether the parent and the family participated in various events situated in Albuquerque that included a science, technology, engineering or math, generally referred to as STEM, focus. Roughly a third (6/30%) noted they did so often or very often, one-half (10/50%) indicated occasionally, and another two each (10%) either seldom or never attended such events.

Q26) My family and I go to free events, like Story Time in the Park, Super STEM Saturday, and Science Fiesta.

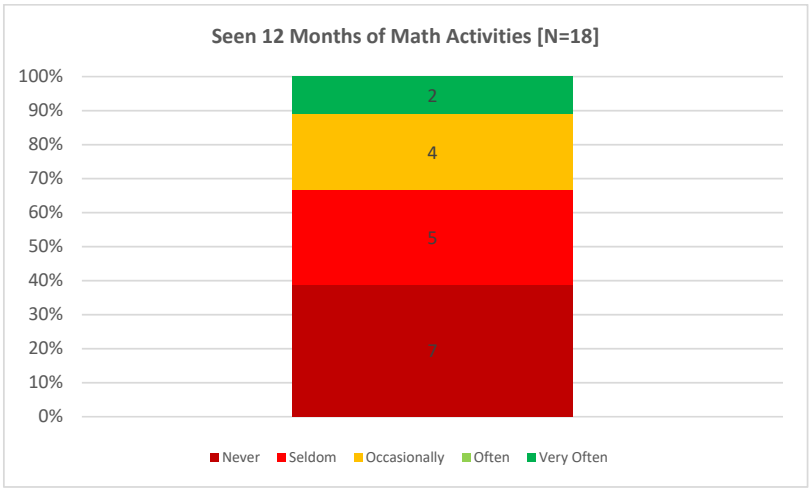


The next two queries included the following framing prompt:

In the last year:

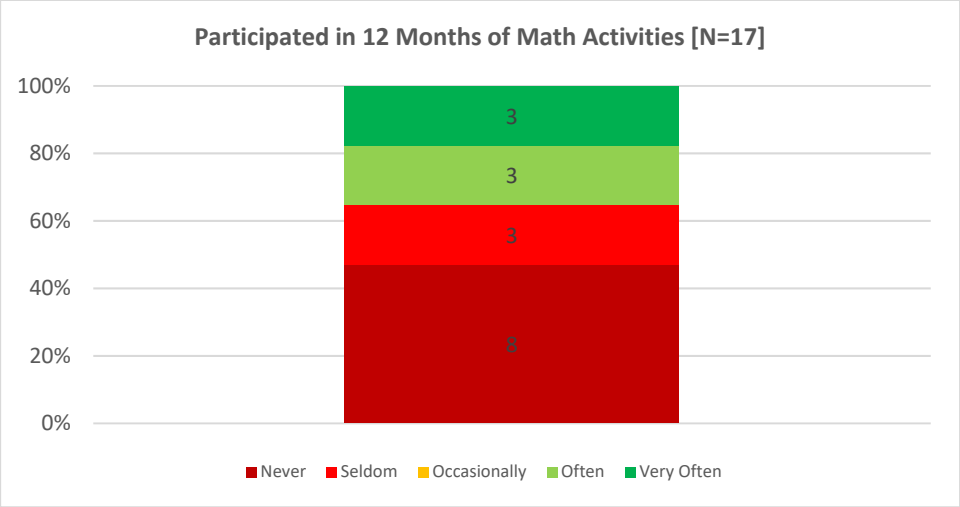
One of the components of the overall project included 12 Months of Math activities that provided a focus on one specific career area that uses math as a key component. The Explora Museum provided this web-based resource to help highlight and make less abstract or unattainable careers that children could enter into as adults once they had mastered mathematics. Explora is the managing agency for the FACESS initiative. Parents apparently did not access this component and it resources to the extent initially anticipated. The survey included no additional question to determine why parents chose to disregard this resource in contrast to others, which they did use. One-third (7/39%) never saw 12 Months of Math activities outside the workshops, another five (28%) did so on a seldom basis, four (22%) saw them occasionally, and two (11%) indicated they saw them very often.

Q27) I have seen 12 Months of Math activities at places like the NM State Fair or the Balloon Park.



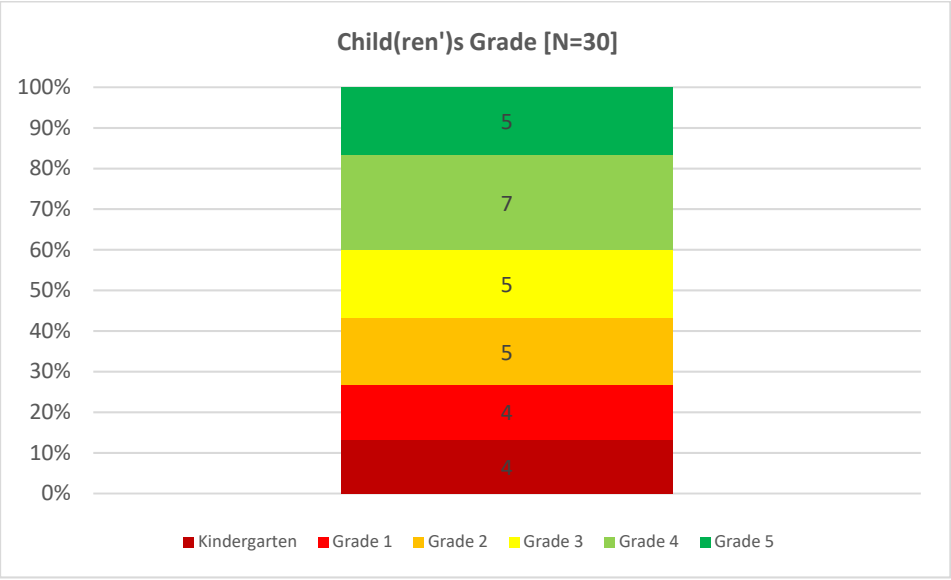
For this next question also related to 12 Months of Math, nearly two-thirds (11/65%) noted they never or seldom participated in related activities, and another six (35%) indicated they had done so either often or very often.

Q28) my family and I have participated in 12 Months of Math activities.



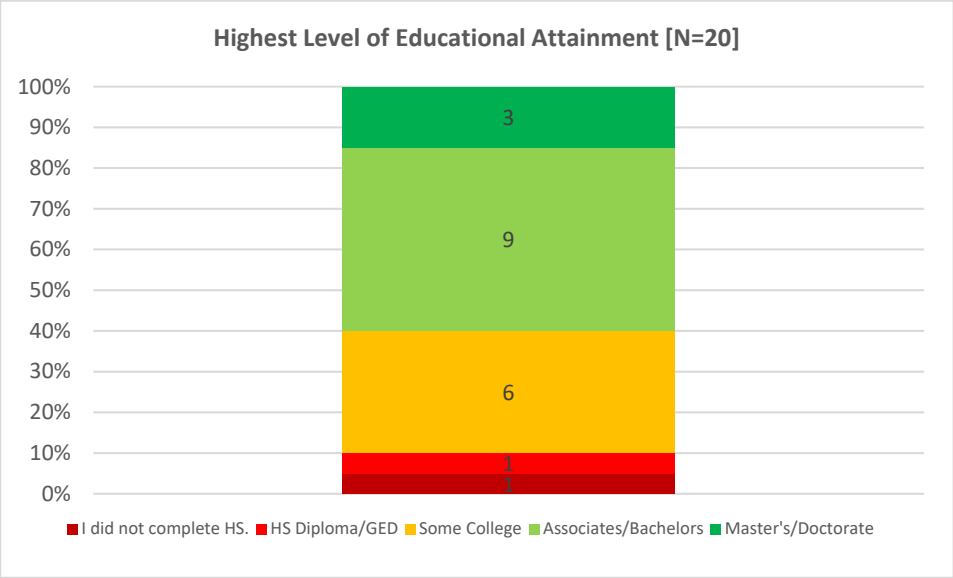
This next question asked what grade or grades their children attended. As many of the parents had more than one child attending one of the participating schools the number of cases (i.e. the "N") amounted to thirty. As shown in the graph, the distribution across grades is dispersed with four (13%) each in grades K and first; five (~17%) each attended grades second, third, and fifth; and seven (~23%) attended fourth.

Q29) What grade or grades is/are your child(ren) in?



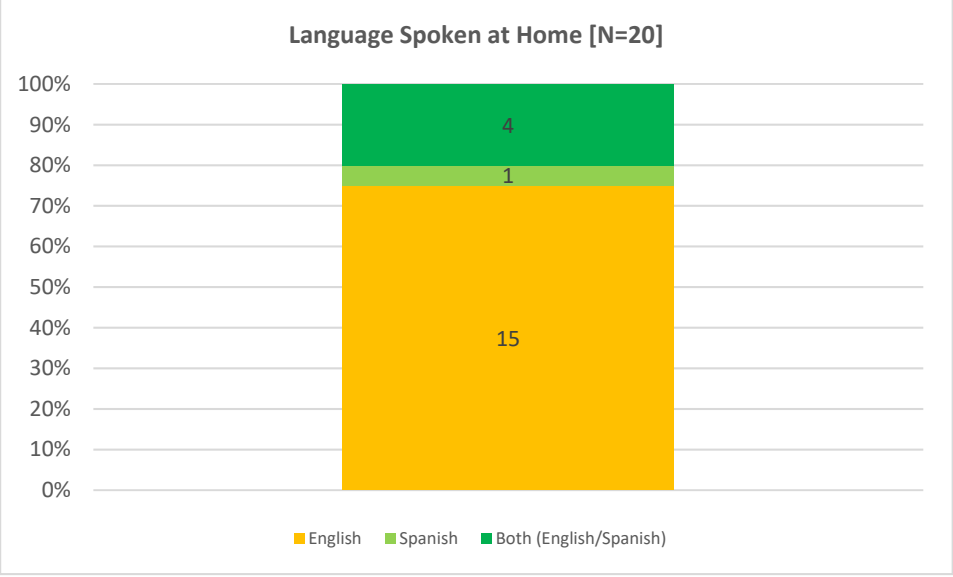
Nearly a third of the parents had at least some college (6/30%), almost half an associate or bachelor's (45%), and another three a graduate degree (15%). One each (5%) noted they had a HS diploma/GED or did not complete HS.

Q30) What is your highest level of educational attainment?



The final question made to parents was the language primarily spoken in the home. Three-quarters (15/75%) spoke English, one (5%) Spanish, and another four (20%) operated as a bilingual household.

Q31) What language(s) do you speak at home?



Student Findings

The first year of the FACESS project surveyed children in the two schools to discern their perspectives on their experience with math. Comprised of twenty-one questions, the survey wanted to uncover, among several things, their:

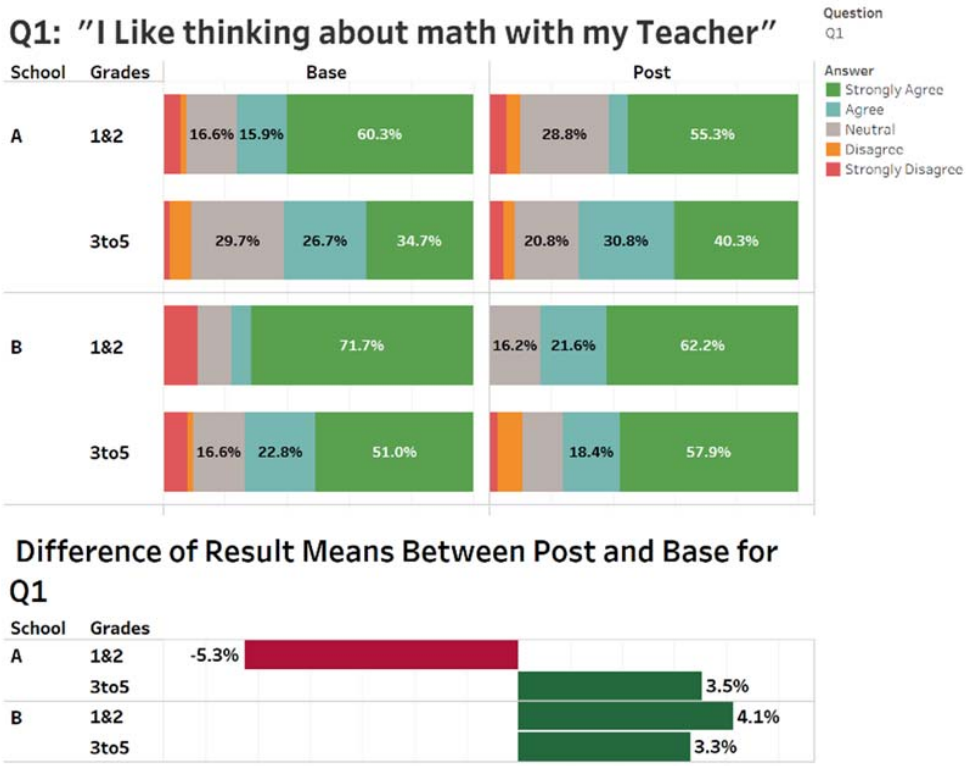
- engagement with math with their teacher and classmates;
- sense of personal efficacy related to math;
- family's support for and their engagement with math;
- perception of math as challenging;
- use of math outside the classroom;
- sense of their friends engagement with math; and
- feelings about math.

With the assistance of the teaching faculty at the two schools, CCPI administered the survey twice, once near the beginning of spring term 2019 and again at the end of that term. The results from these two administrations appear below with the "base" being the first administration, and the "post" being the second. The first administration included all grades K-5 in the two schools; however, the administration to the kindergarten children proved overly problematic as the children were unfamiliar with how survey completion worked and needed their teacher to provide a full explanation for each question. Because this additional help appeared excessive, the PI and team concluded that it likely skewed the results for kindergarten and thus removed those findings from the data set. Consequently, the second survey administration only included grades 1-5.

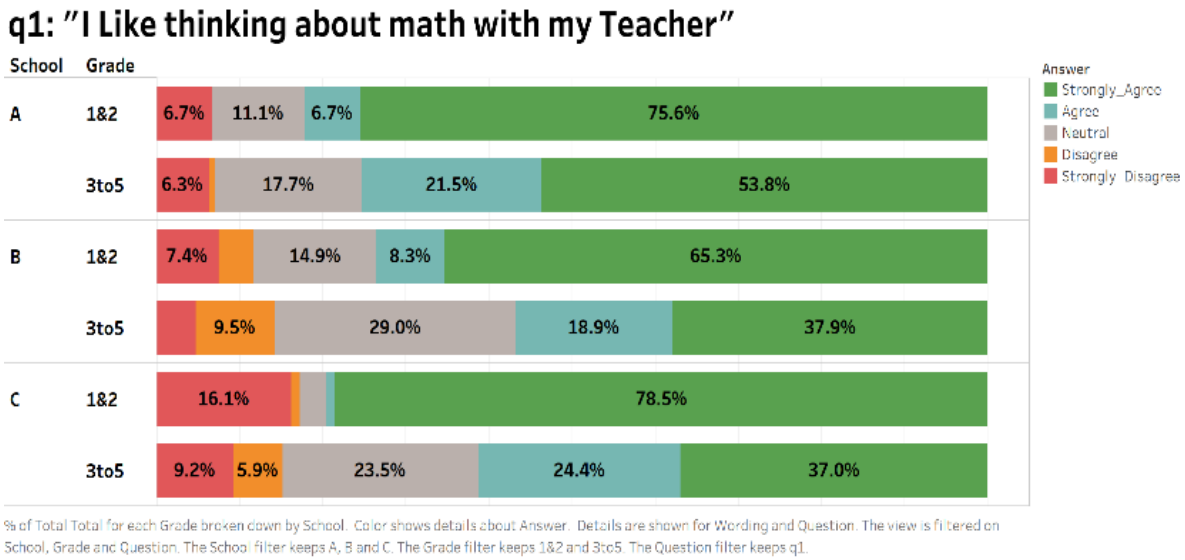
To avoid an excess number of graphs grades 1-2 and grades 3-5 findings have been consolidated into groups and separated by school indicators A&B to preserve anonymity of the participants. Each graph shows results as percentages to facilitate comparison of the changes between base and post points in time, with the difference of result means shown in the second graph for each query. For each of the following graph sets, the difference of means measures the percent difference between the mean values for each response set across the two points in time.

As noted earlier, the research team included a third school in the study during the second year of data collection. The second year included an administration of the survey in the early part of the fall semester and included all three schools. Since this occurred in the fall of 2019, the expectation was that we would have a full year of engagement with teachers, students and parents, with a subsequent second round of surveys administered to the various groups in late spring 2020. The outbreak of the Covid19 pandemic dashed these expectations and neutralized the ability to complete the second round of surveys and develop the data set that would have enabled completion of a pre/post analysis. As a result, the report is only able to show the results from the year two fall administration of the student survey. These graphs appear immediately after the year one results.

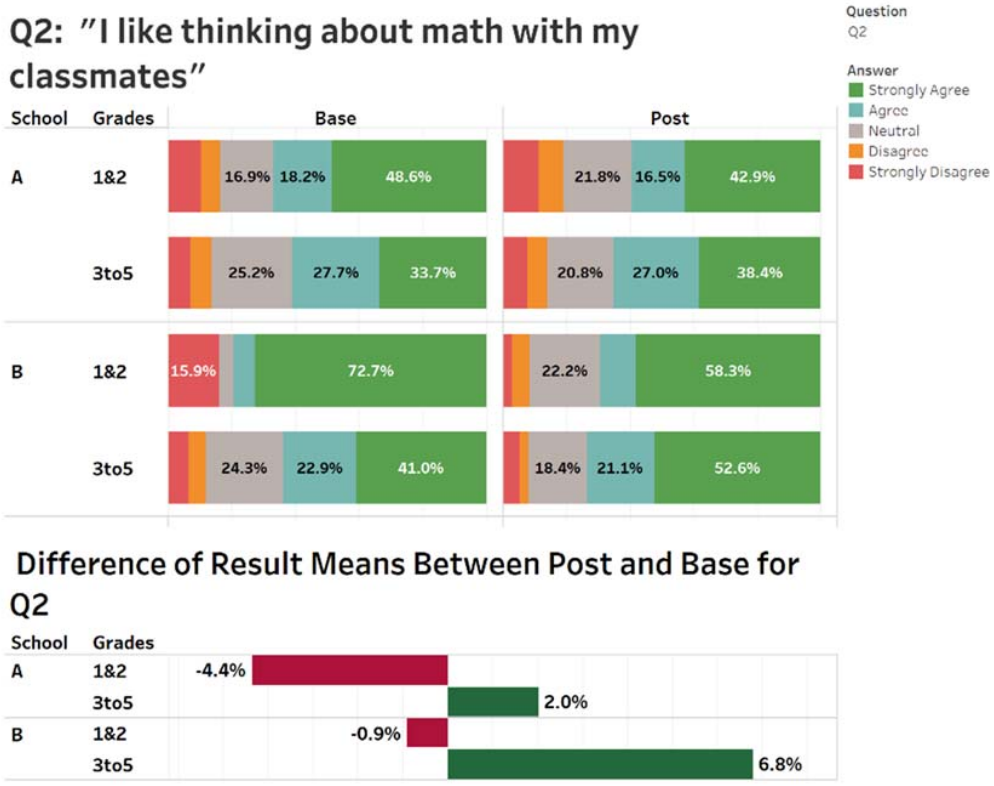
The first query prompted the students to indicate to what degree they agreed with the statement "I like thinking about math with my teacher." As noted in the second graph, at School A, the difference of result means for grades 1 & 2 declined 5.3% and for grades 3 to 5, they increased 3.5% between base and post. At School B, grades 1 & 2 showed an increase of 4.1% and 3.3% for grades 3 to 5 between the two points in time.



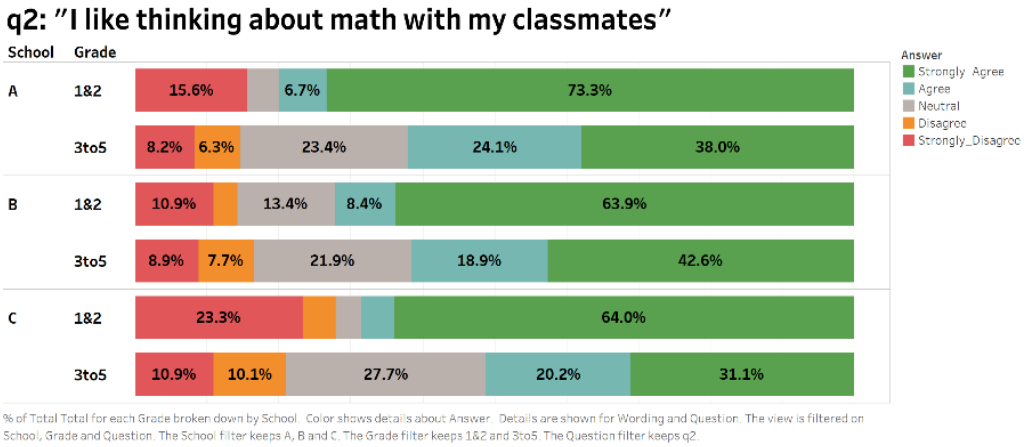
For the first question, the year two results for grades 1 & 2 across the three schools show relatively high percentages of students who strongly agree with the statement, "I like thinking about math with my teacher. " Two schools show 3/4s (A:75.6%; C:78.5%) and the other school shows 2/3s (B:65.3%) of the students indicating the choice of strongly agree. In grades 3 to 5, the students who chose strongly agreed declined to a little more than 1/3 at two schools (B:37.9; C:37.0%) and slightly more than ½ at the third school (A:53.8%).



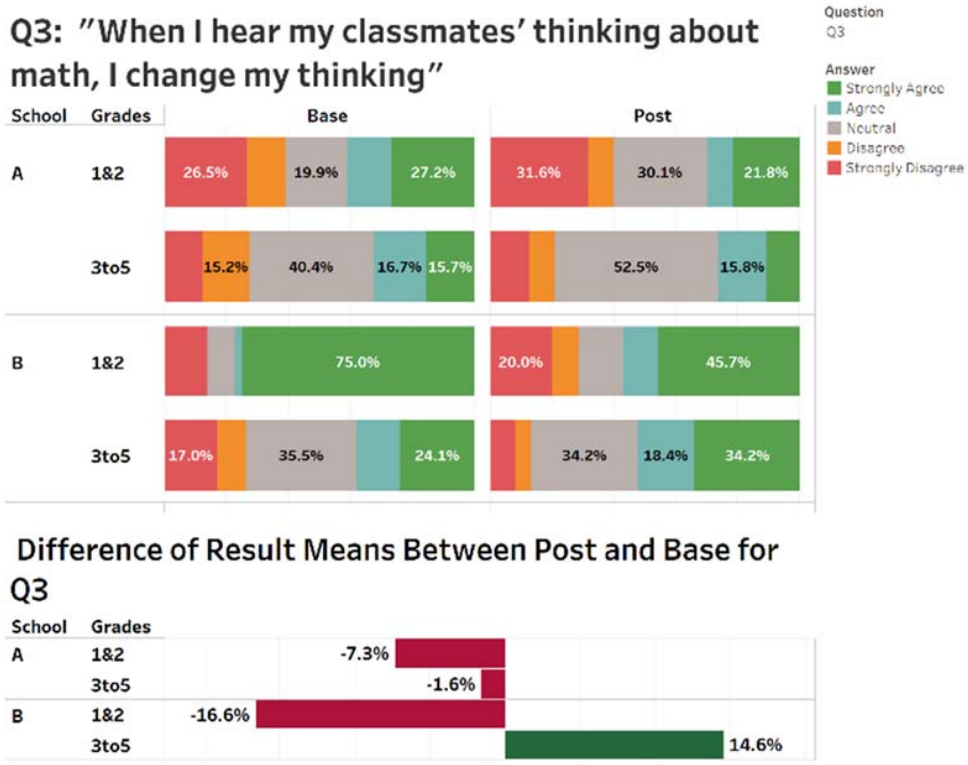
The second query probed on their level of agreement with the statement "I like thinking about math with my classmates." For the difference in result means between the two points in time, the patterns for the two schools are similar in that both saw a decline in level of disagreement for grades 1&2 with School A (-4.4%) more pronounced than B (-0.9%), and an increase for grades 3&5 at School A (2.0%) and 6.8% for School B.



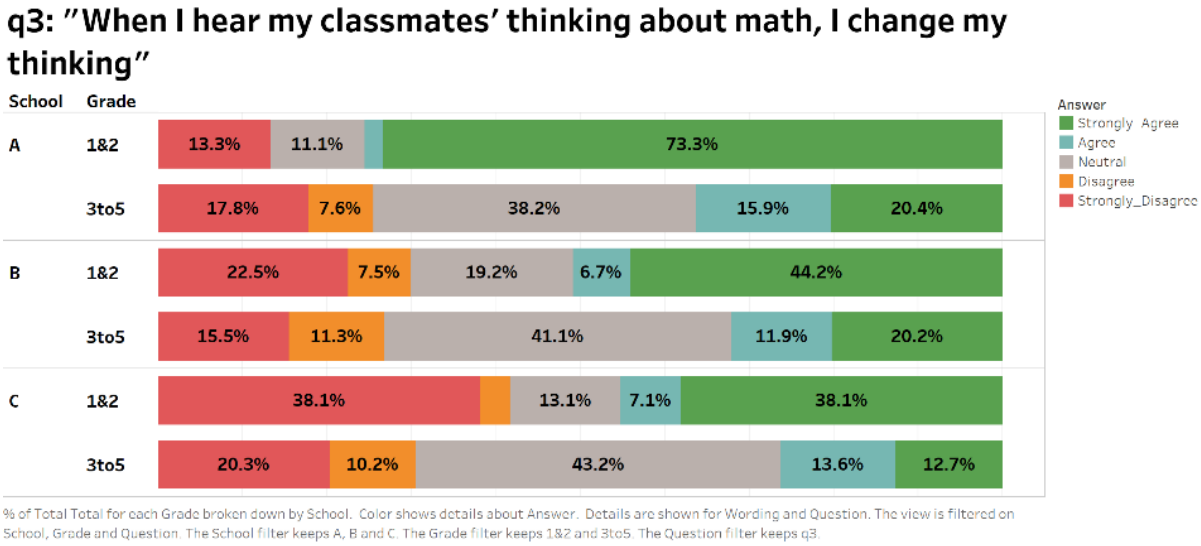
The second query posed the prompt, "I like thinking about math with my classmates." Here again, relatively high percentages of year two students from grades 1 & 2 strongly agreed in all three schools with two at nearly 2/3s making this selection (B:63.9%; C:64.0%) and the third school where nearly 3/4s of the students chose the option (A:73.3%). In grades 3 to 5, these percentages drop off to nearly 40% for two schools (A:38.0%; B:42.6%), and to less than 1/3 for the third (C:31.1%)



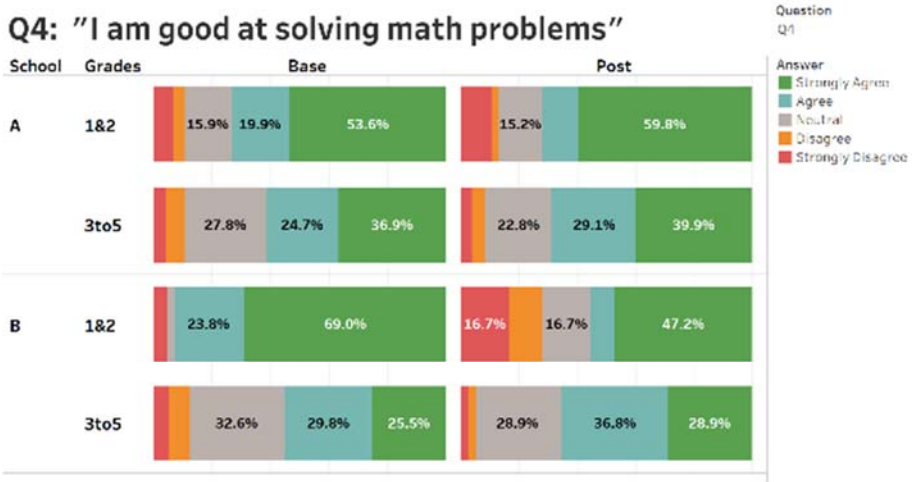
The following query wanted to uncover whether students agreed they changed their thinking after listening to their classmates thinking about math. In response, the difference in result means show both grade groups at School A reduced their levels of agreement by -7.3% for 1&2, and -1.6% for 3 to 5. At school B, the level of agreement dropped -16.6% in grades 1 & 2 and increased by 14.6% for grades 3 to 5.

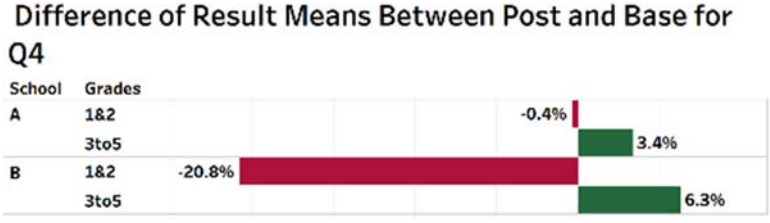


For the third query on whether year two students agreed they changed their thinking when they hear their classmate's thinking on math, the results for those who selected strongly agreed in grades 1 & 2 are significantly different among School A (73.3%) and Schools B (44.2%) and C (38.1%). For grades 3 to 5, about 1/5 of the students in two schools (A:20.4%; B:20.2%) selected strongly agreed and the third school dropped further (C:12.2%).

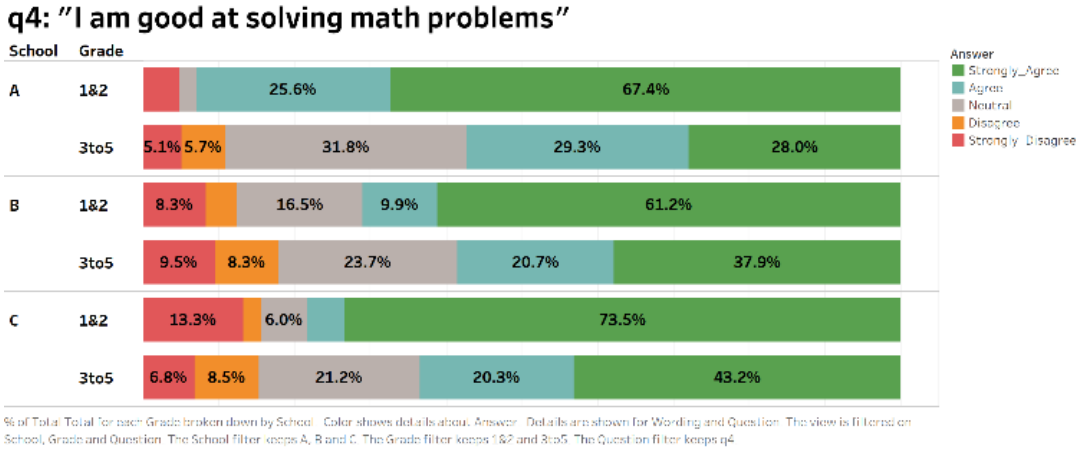


Getting a sense of the personal efficacy of students solving math problems served as the focus of the following. While there was a decline in the difference of result means for both schools in grades 1 & 2 of -0.4 and -20.8%, for A & B, respectively; grades 3 to 5 for both schools showed increases of 3.4% and 6.3%, respectively.

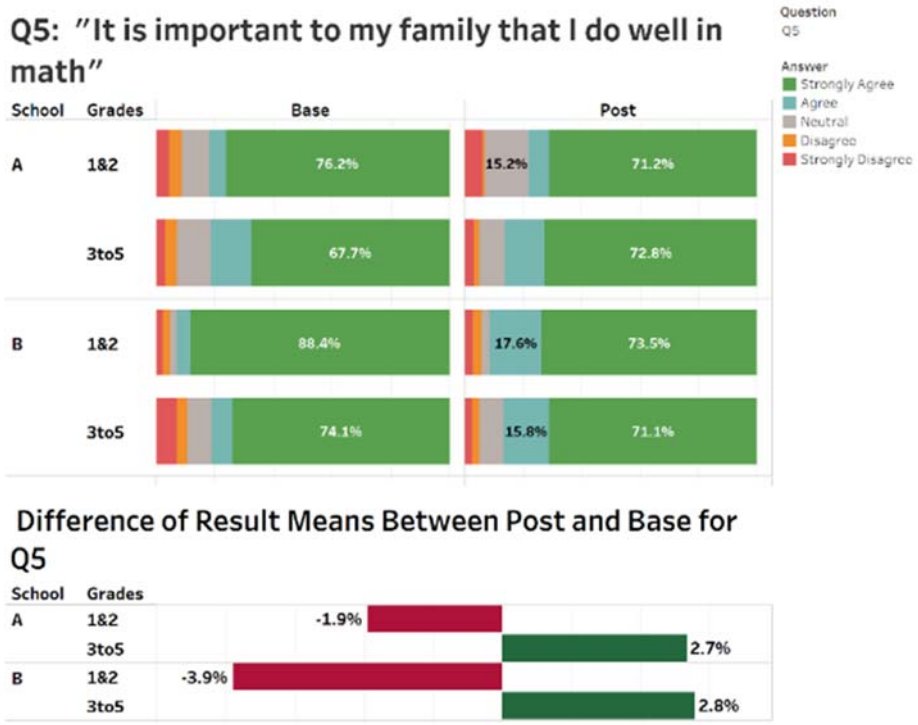




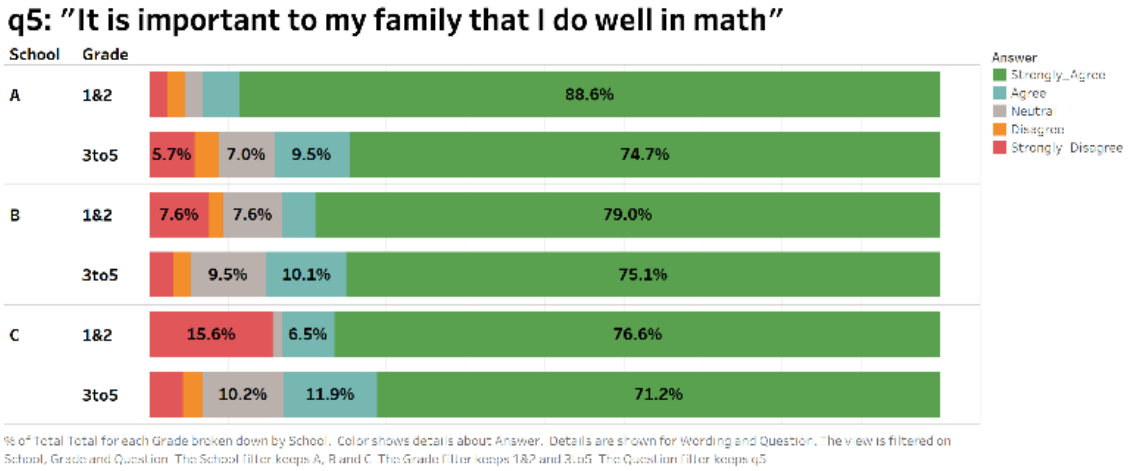
In year 2, when asked to what level they agreed with the statement "I am good at solving math problems," large percentages of students in grades 1 & 2 in all three schools (A:67.4%;B:61.4%;C73.5%) selected strongly agreed. These percentages dropped off in grade 3 to 5 across all three schools (A:28.0%;B:37.9%; C:43.2%).



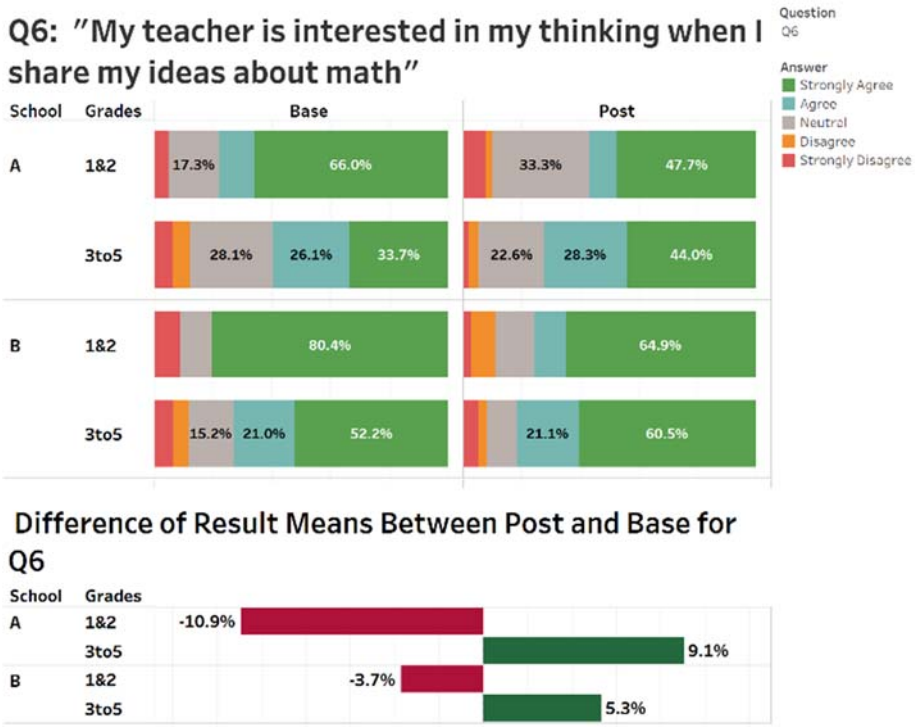
Family support for doing well at school can be a significant factor for improving the probability of academic success. This prompt sought to determine whether students agreed that, "It is important to my family that I do well in math." At both schools, the difference of result means for grades 1 & 2, the level of agreement declined -1.9% and -3.9% for A and B, respectively; and increased for grades 3 to 5 by 2.7% and 2.8%, respectively by school.



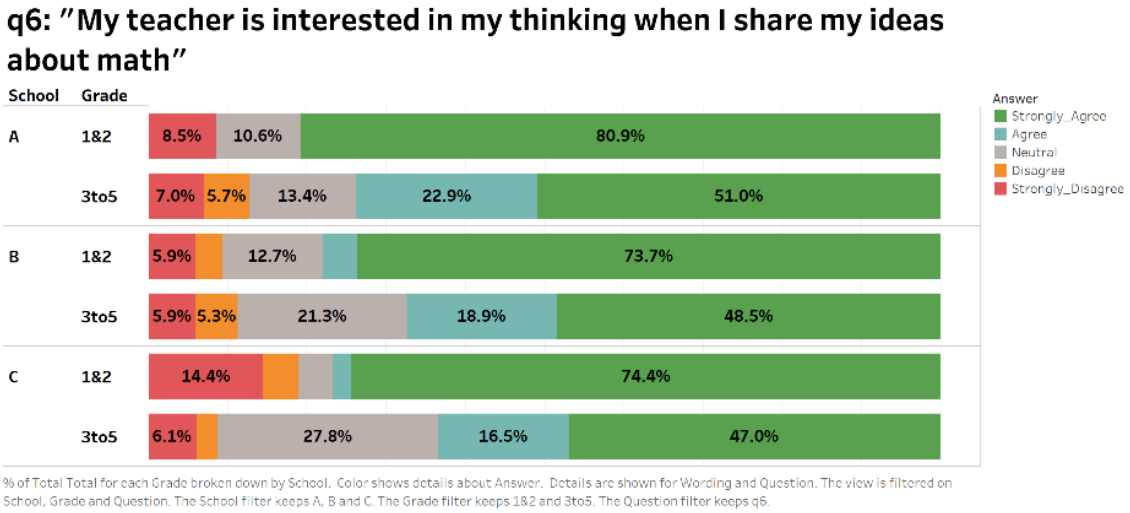
Many of the year 2 students across all the grade groups and schools strongly agreed with the statement, "It is important to my family that I do well in math." The percentages range from roughly 70% at one school to nearly 90% at another. For grades 1 & 2, the percentage of students at each school were A:88.6%; B:79.0%, and C:76.6%. In grades 3 to 5, these percentages are A:74.4%; B:75.1%; and C:71.2%.



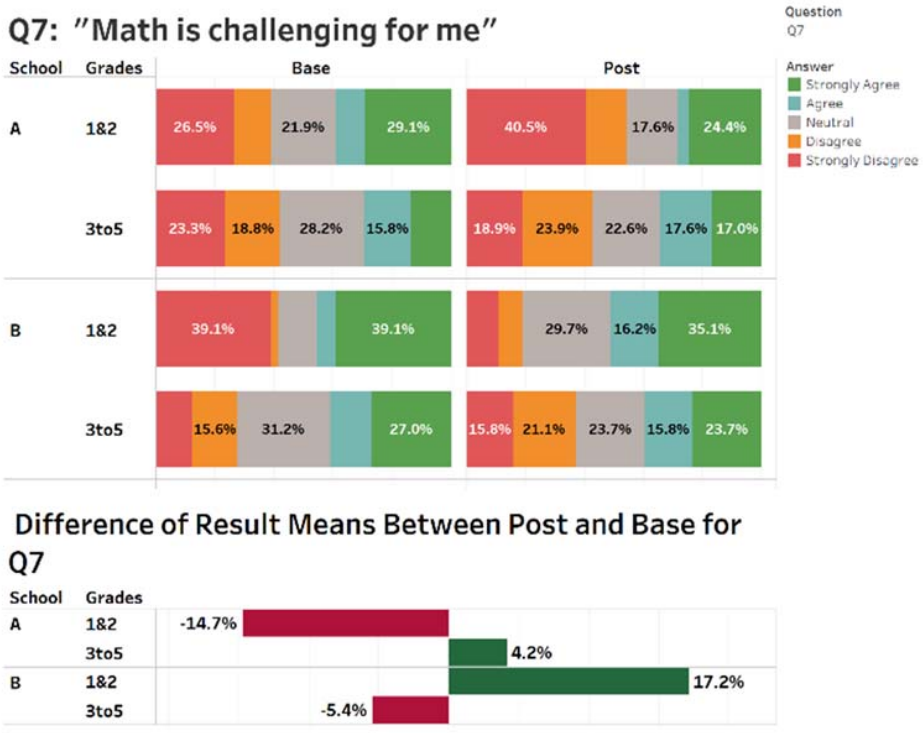
Determining how students perceived the level of interest their teachers exhibited towards their thinking when they shared their thoughts about math served as the focus of this next prompt. In both schools, A & B, the difference of result means in grades 1 & 2 declined by -10.9% and -3.7%, respectively, and increased for grades 3 to 5 by 9.1% and 5.3% for the two schools.



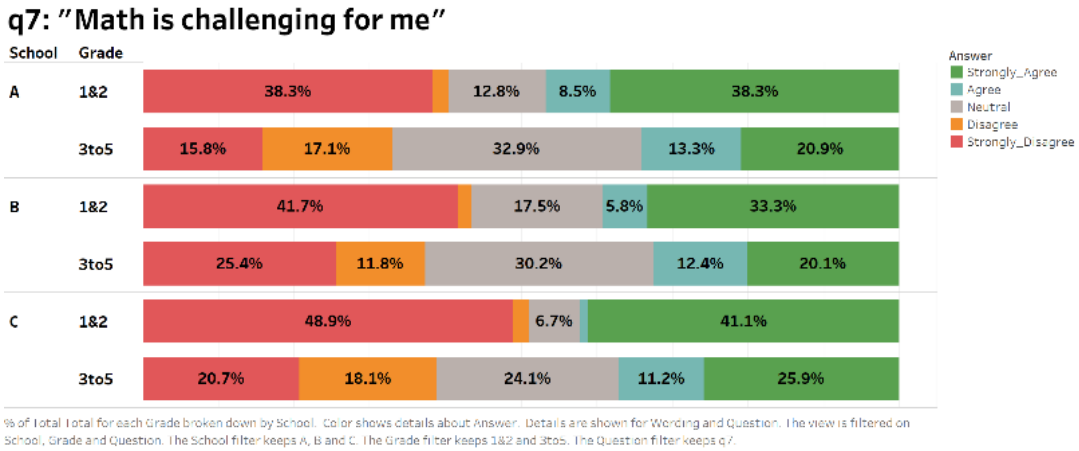
The percentages of year 2 students who strongly agreed with the statement, "My teacher is interested in my thinking when I share my ideas about math," were quite high for grade 1 & 2 across all three schools (A:80.9%; B:73.7%; and C:74.4%). The percentages dropped off to nearly 1/2 for grades 3 to 5 (A:51.0%; B:48.5%; and C:47.0%).



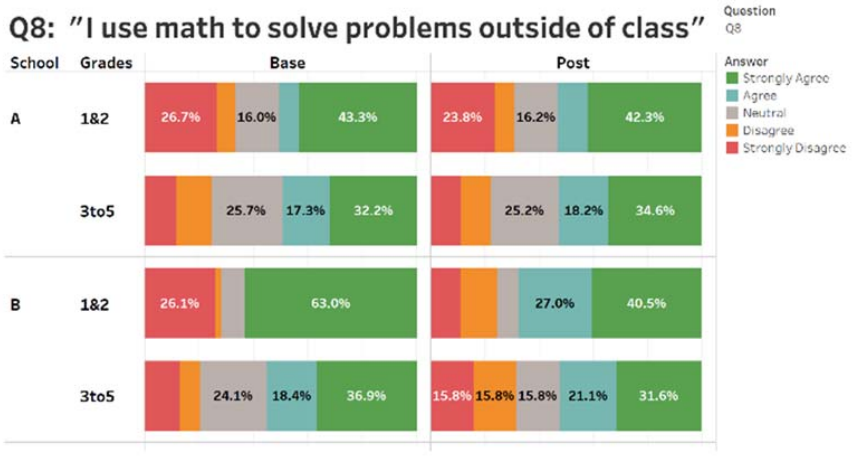
Math can be a challenge for many students. The query in the following posed whether students agreed that they found math a challenge. The percentages of students who strongly disagreed with the statement suggest they felt capable and empowered when dealing with math. As reflected in the difference of results means, grades 1 & 2 showed a decline of -14.7% at School A and increased by 17.2% in School B. In grades 3 to 5, the difference increased by 4.2% at School A and decreased by -5.4% at B.

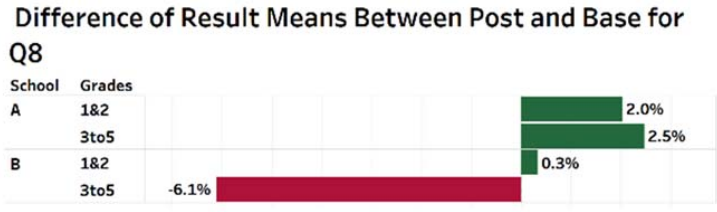


In response to the following query, "Math is challenging for me," the results are mixed in terms of the number of year two students who agreed or disagreed. As noted above, students who strongly disagreed with the statement indicate they felt capable and empowered when dealing with math. However, we only see a group in grades 1 & 2 in School C at 48.9%, while the students in grades 3 to 5 who chose that option came in at 20.7%. For School A, the split between the grade levels for those who chose strongly disagreed comes in at 38.3% for grades 1 & 2 and 15.8% for grades 3 to 5. At School B, the percentages tick up somewhat in that 41.7% of grade 1 & 2 students chose strongly disagreed and 25.4% of those in grades 3 to 5 selected that option.

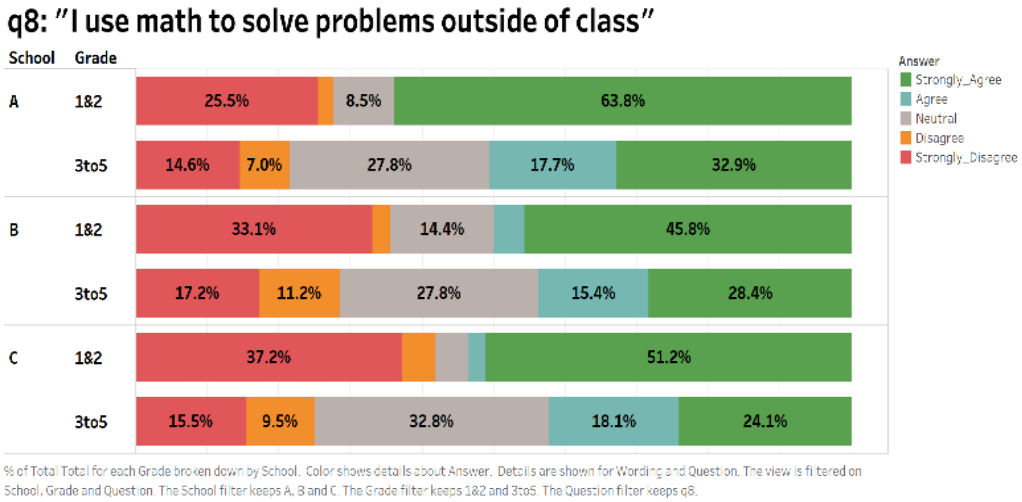


Using math outside the classroom can assist students to realize the extent to which mathematics has an impact on everyday life. The following query sought to get at the degree to which students agreed with a question on this dimension. At School A, the difference of results means positively increased in both grade groups of 2.0% for 1 & 2, and 2.5% for grades 3 to 5. At School B, grades 1 & 2 increased by 0.3%, and decreased in grades 3 to 5, by 6.1%

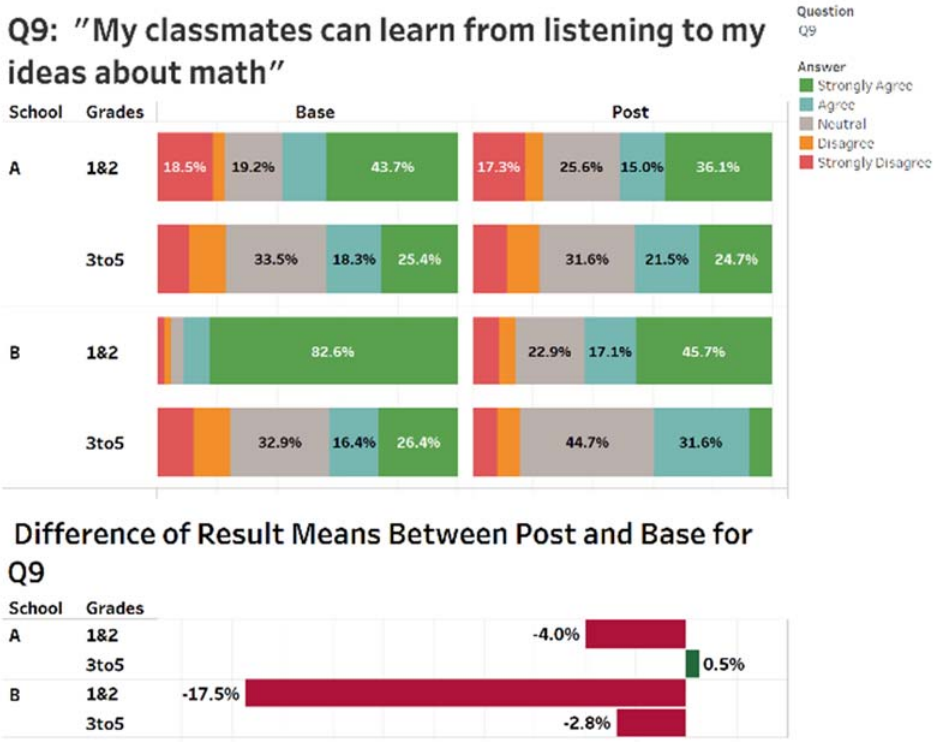




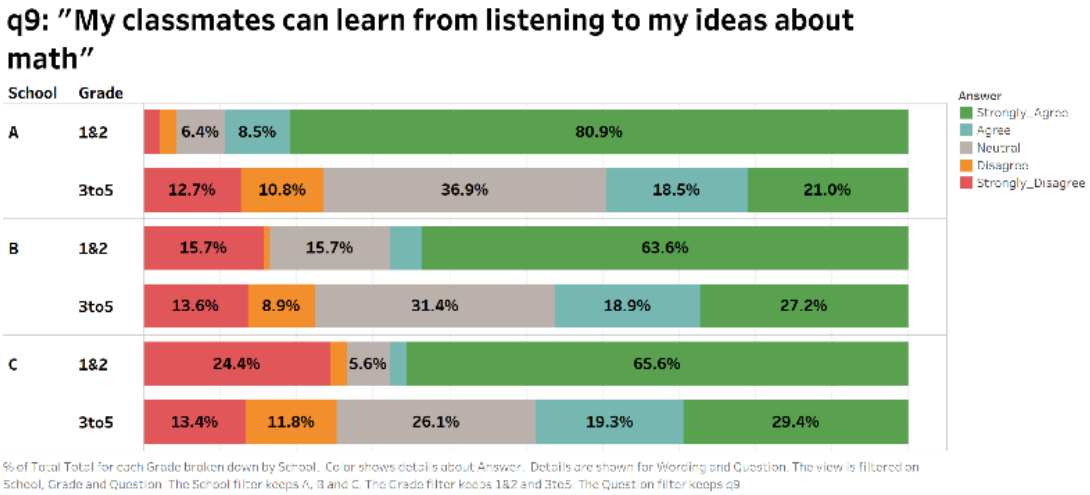
Using math in everyday applications helps support the learning that students experience in the classroom. In response to the prompt, "I use math to solve problems outside of class," the percentages of year two students in grades 1 & 2 who chose strongly agreed was varied across the three schools with 63.8% at A, 45.8% at B, and 51.2% at C. For grades 3 to 5, the percentages who made this selection came in at 32.9% for A, 28.4% at B, and 24.1% at C.



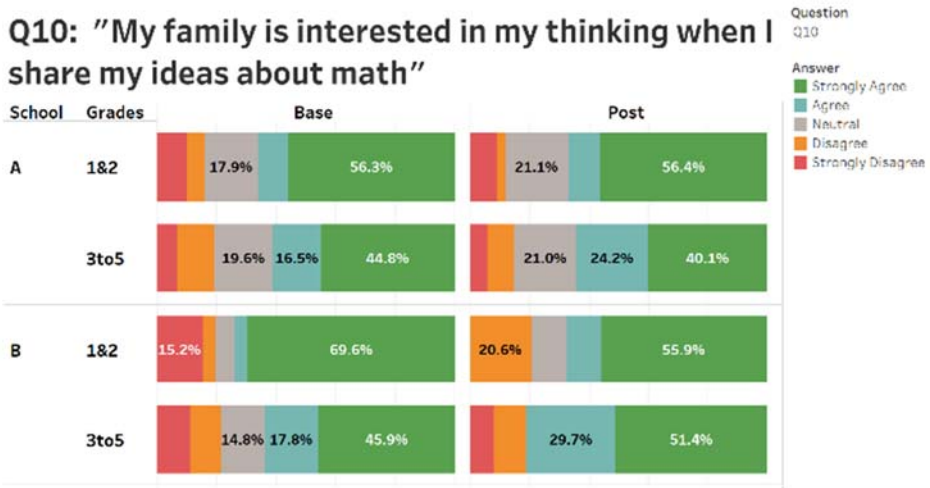
Posing the flip side to query 3, the following sought to uncover whether the respondents agreed other students could learn things about math when she gave her ideas about math. At School A, the difference in agreement in grades 1 & 2 declined by -4.0% and -17.5% at School B. For grades 3 to 5, the difference at School A increased by 0.5% and decreased at School B by -2.8%.

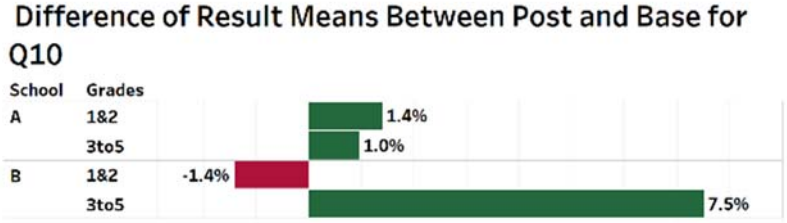


Year 2 students who strongly agreed that their classmates can learn from listening to their ideas about math made up fairly large majorities in grades 1 & 2 across all three schools (A:80.9%; B:63.3%; and C: 65.6%). These figures drop precipitously in grades 3 to 5 as shown for each school (A:23.0%; B:27.2%; and C:29.4%).

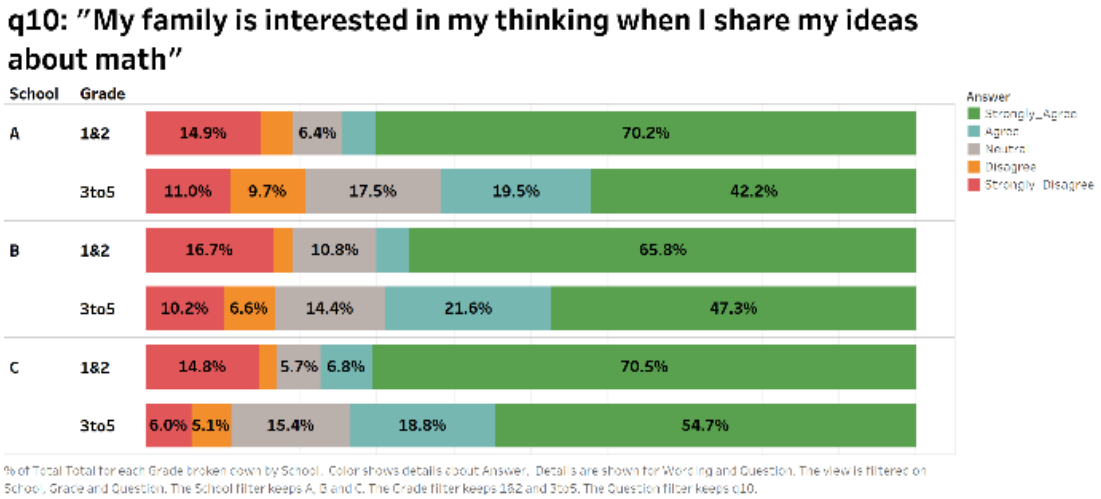


Serving to determine another dimension related to family support for children related to math, the next query posed how much students agreed that, "My family is interested in my thinking when I share my ideas about math." Whereas, at School A, both grade groups showed increases in the difference of result means of 1.4% in Grades 1 &2 and of 1.0% for grades 3 to 5; the grade group 1 & 2 at School B showed a decline in agreement of -1.4% and for grades 3 to 5, an increase of 7.5%.

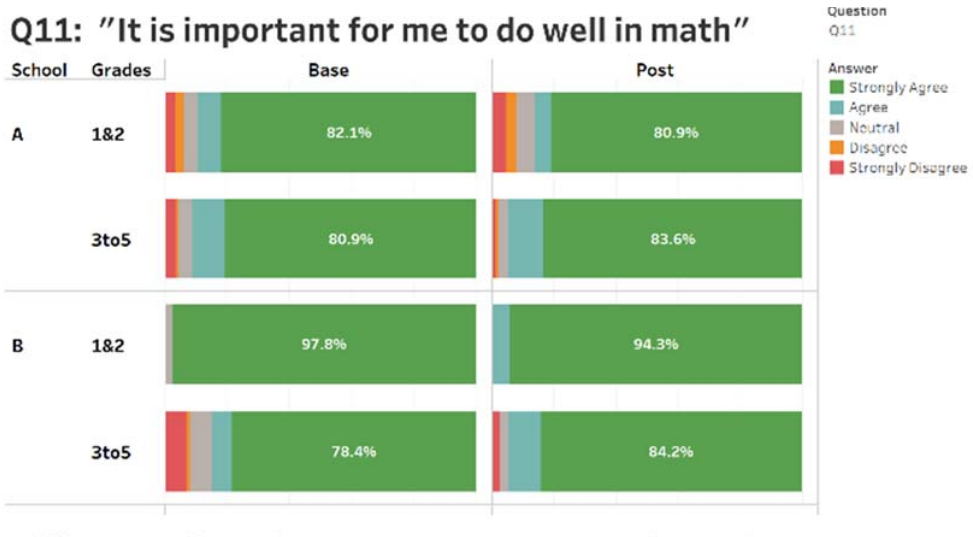


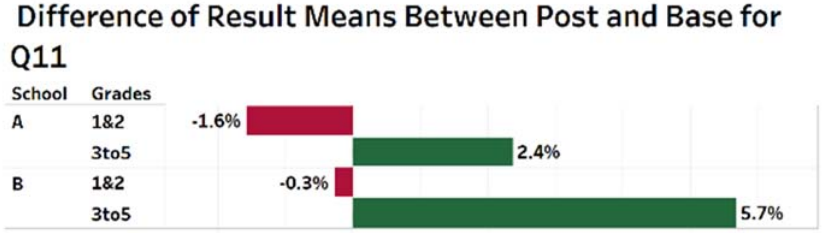


Students in grades 1 & 2 for year two who strongly agreed that their family is interested in their thinking when they share ideas about math show strong majorities across all three schools (A:70.2%; B:65.8%; and C:70.5%). These percentages drop for students in grades 3 to 5 as shown by these figures (A:42.2%; B:47.3%; and C:54.7%).

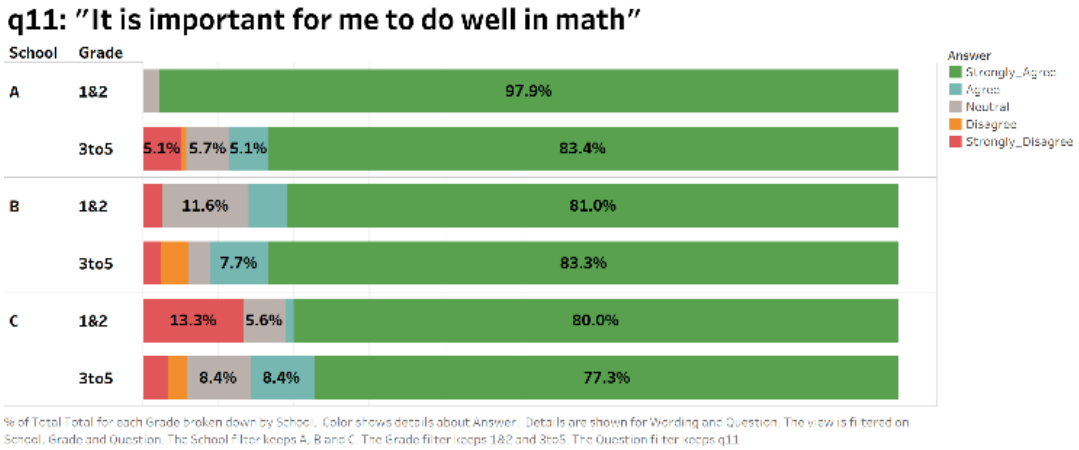


If a child has a high sense of expectation related to their academic performance, it can exert a considerable effect on how this performance unfolds. The next query, "It is important for me to do well in math," sought to determine the degree to which students agreed with the statement. At both schools, the 1 & 2 grade group scores had a decline in the difference of result means of -1.6% and -0.3% for A and B. Conversely, both schools showed increases in the level of agreement found in grades 3-5 of 2.4% and 5.7%, respectively.

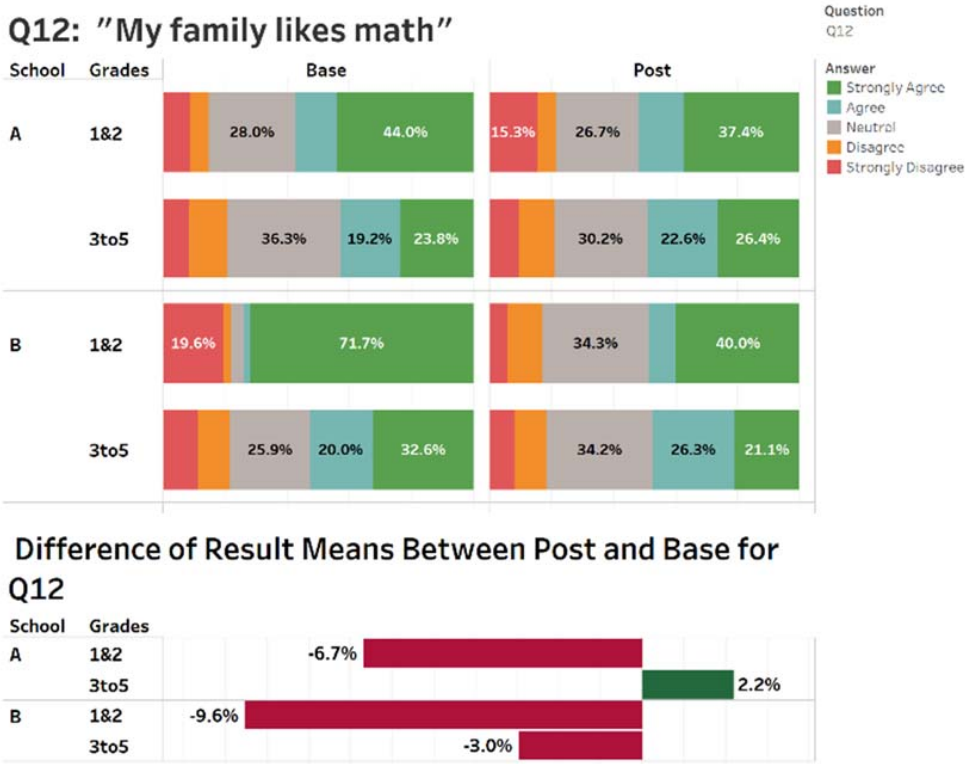




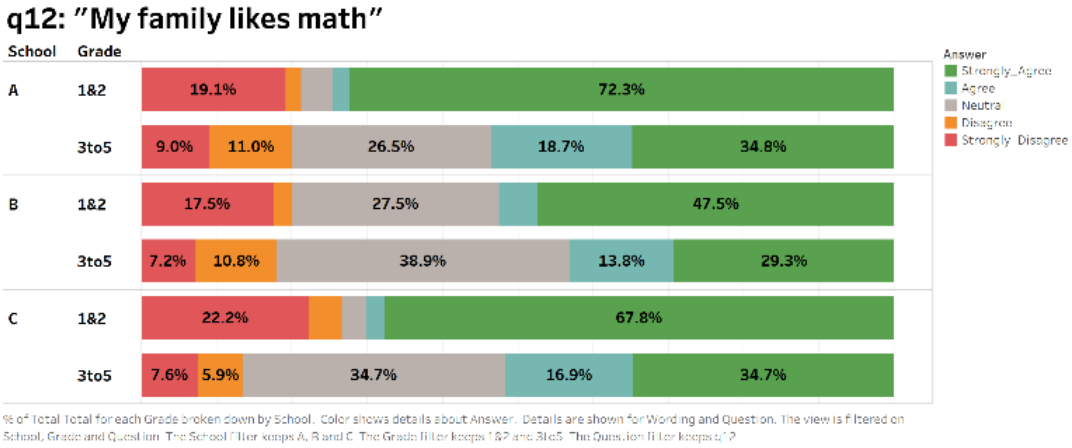
As the results for year two show below, students clearly hold the message in mind that "It is important for me to do well in math." For grades 1 & 2, for those who strongly agreed with that statement, at School A, a stunning 97.9% made that choice; and large majorities at School B and C, chose that response with percentages of 81.0% and 80.0%, respectively. For grades 3 to 5, the percentages who made that selection at each school were nearly as high with 83.4% at A, 83.3% at B, and 77.3% at C.



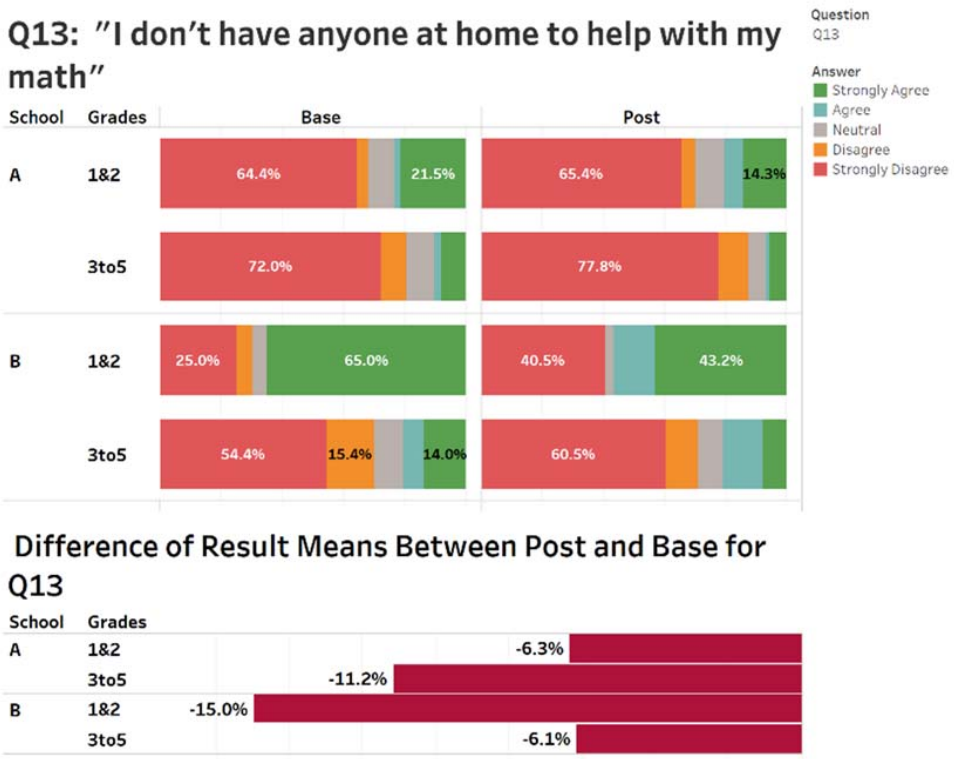
Whatever the attitude that family members have towards math can influence a child's perspective for good or naught. The next question ask students to indicate the level to which they agreed with the statement, "My family likes math." As reflected in the difference of results means graph, student agreement with the statement at School A declined by -6.7% in grades 1 & 2, but increased by 2.2% in grades 3 to 5. The means difference at School B declined by -9.6% in grades 1 & 2 and -3.0% in grades 3 to 5.



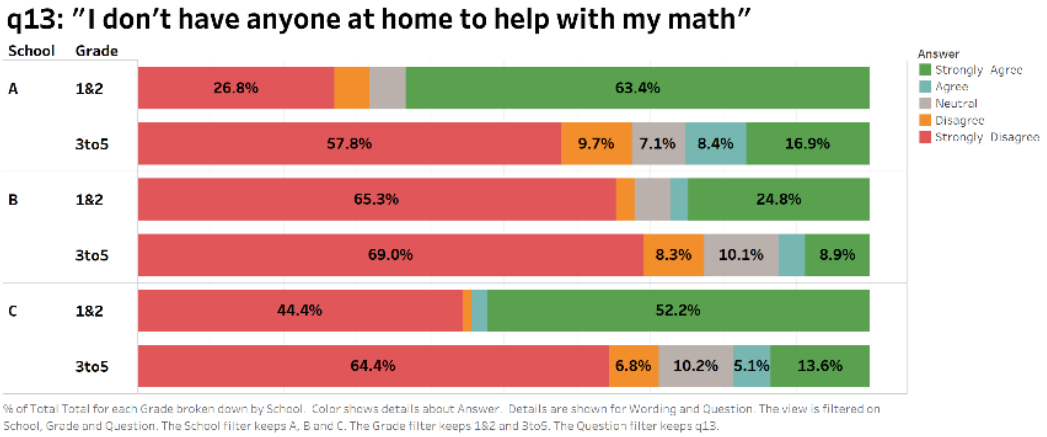
Asked about whether they agreed with the prompt, "My family likes math," strong majorities of year two students in grades 1 & 2 appeared in School A (72.3%) and School C (67.8%) and only showed 47.5% at School B. None of the students in grades 3 to 5 reached a majority for those who strongly agreed with the statement as these figures reflect (A:34.8%; B:29.3%; and C:34.7%).



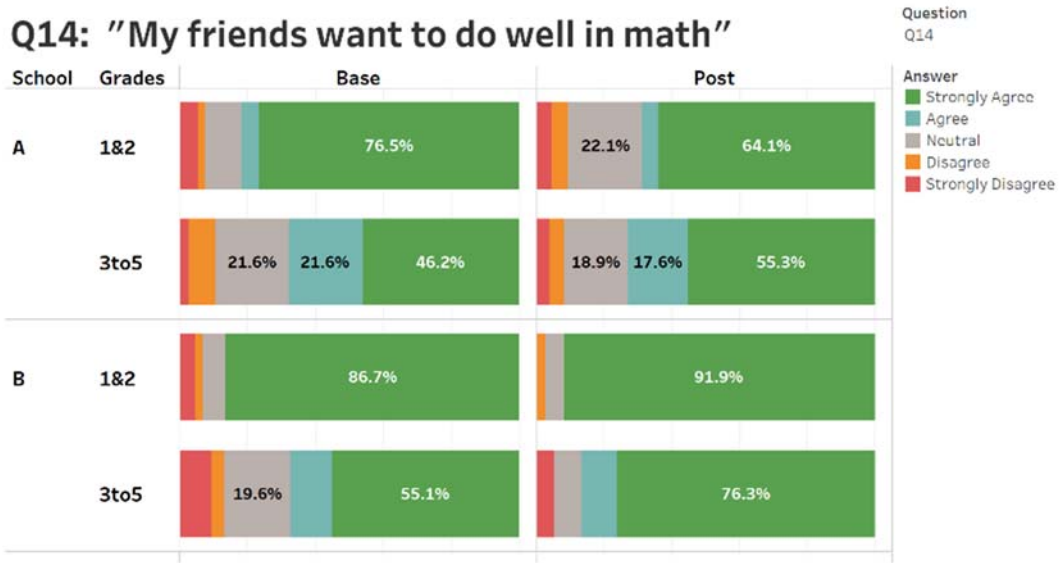
At both levels and both schools, the difference of result means graph shows students uniformly disagreed with the statement, "I don't have anyone at home to help with my math." For instance, students in grade 1 & 2 at School A had a decline of -6.3% and at School B, a decline of -15.0%. For grades 3 to 5, the decrease at School A was -11.2%, and at School B, 6.1%.

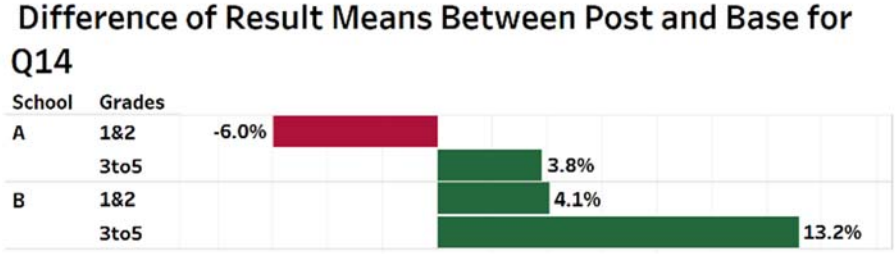


When asked whether they agreed with the statement, "I don't have anyone at home to help with my math," year two majorities at Schools A and C strongly agreed with percentages of 63.4% and 52.2%, respectively. With a contrary finding, 65.3% of the students in grades 1 & 2 at School B strongly disagreed with the statement. In grades 3 to 5, majorities of 57.8%, 69.0% and 64.4%, made that selection at Schools A, B, and C, in turn.

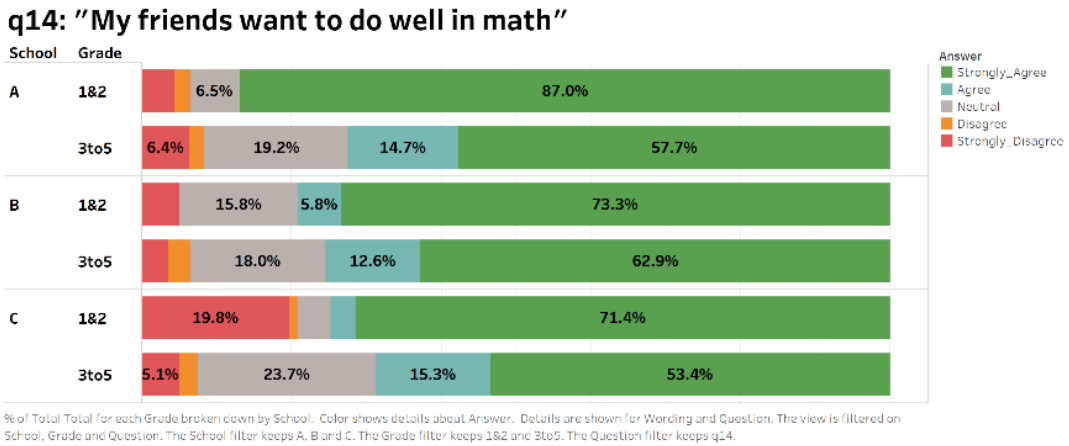


The influence of peers can be a major determinant in how children approach their academic performance. When asked about their level of agreement with the statement, "My friends want to do well in math," the difference of results mean at School A declined by -6.0% in grades 1 & 2 but increased by 3.8% in grades 3 to 5. At School B, the difference increased at both levels by 4.1% in 1 & 2 and 13.2% in 3 to 5.

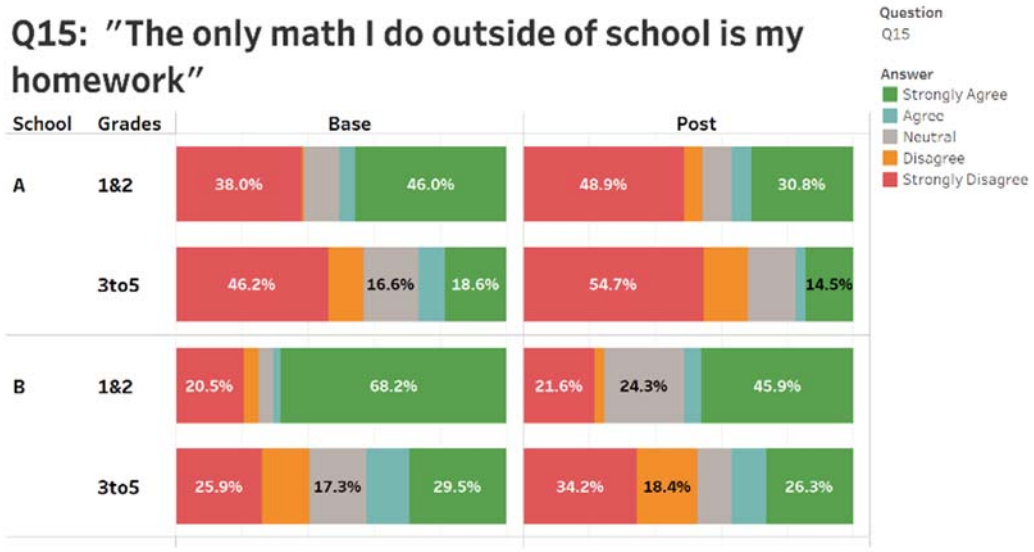


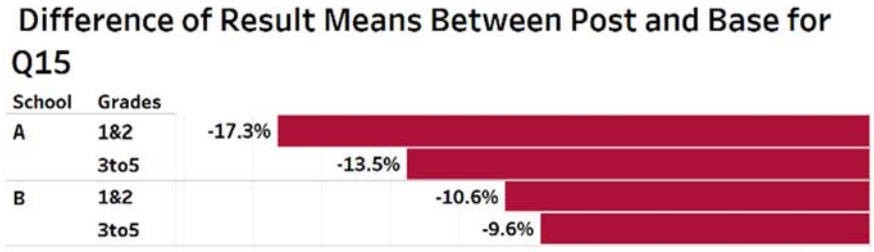


In year 2, majorities of students in both grade groups and all three schools strongly agreed that their friends want to do well at math. For grades 1 & 2, School A showed 87.0%, School B came in at 73.3% and School C with 71.4% made that choice. In grades 3 to 5, 57.7% of School A , 62.9% of School B, and 53.4% of School C students selected that option.

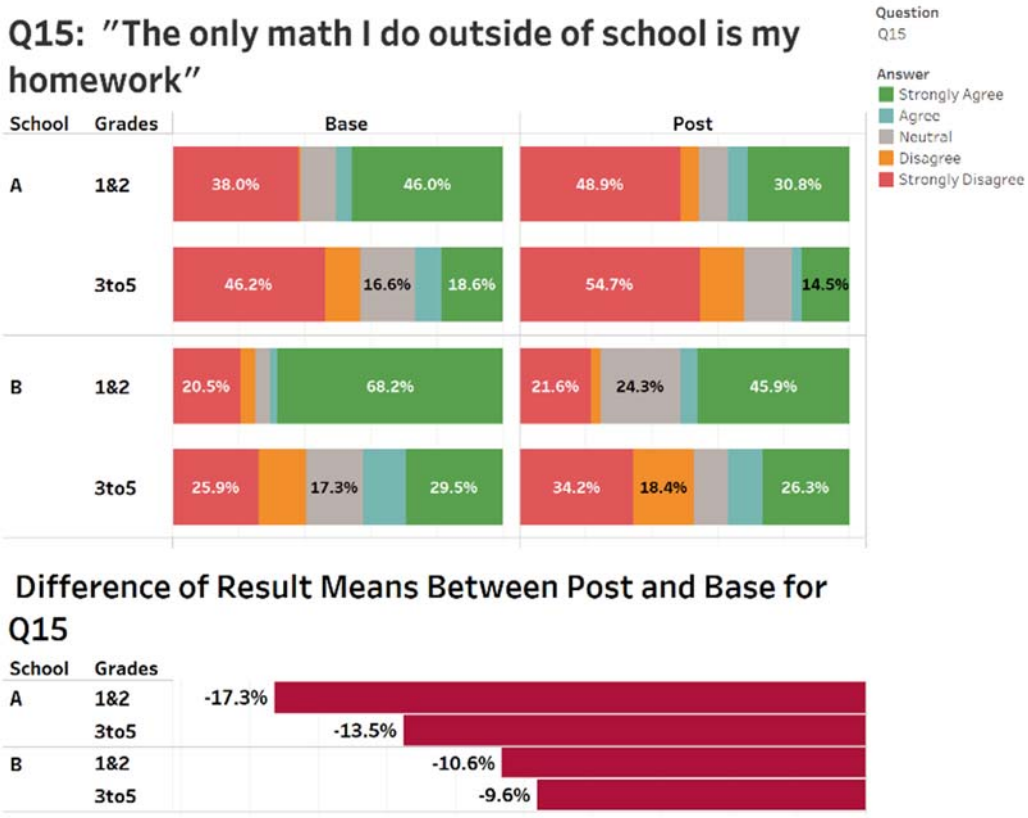


As in query 8, the next one also focused on what math besides homework a student did outside of school. The difference of result means graph showed a decrease in grades 1 & 2 of -17.3% at School A, and -10.6% at School B. For grades 3 to 5, the difference of result means declined by -13.5% at School A, and at by 9.6% at School B.

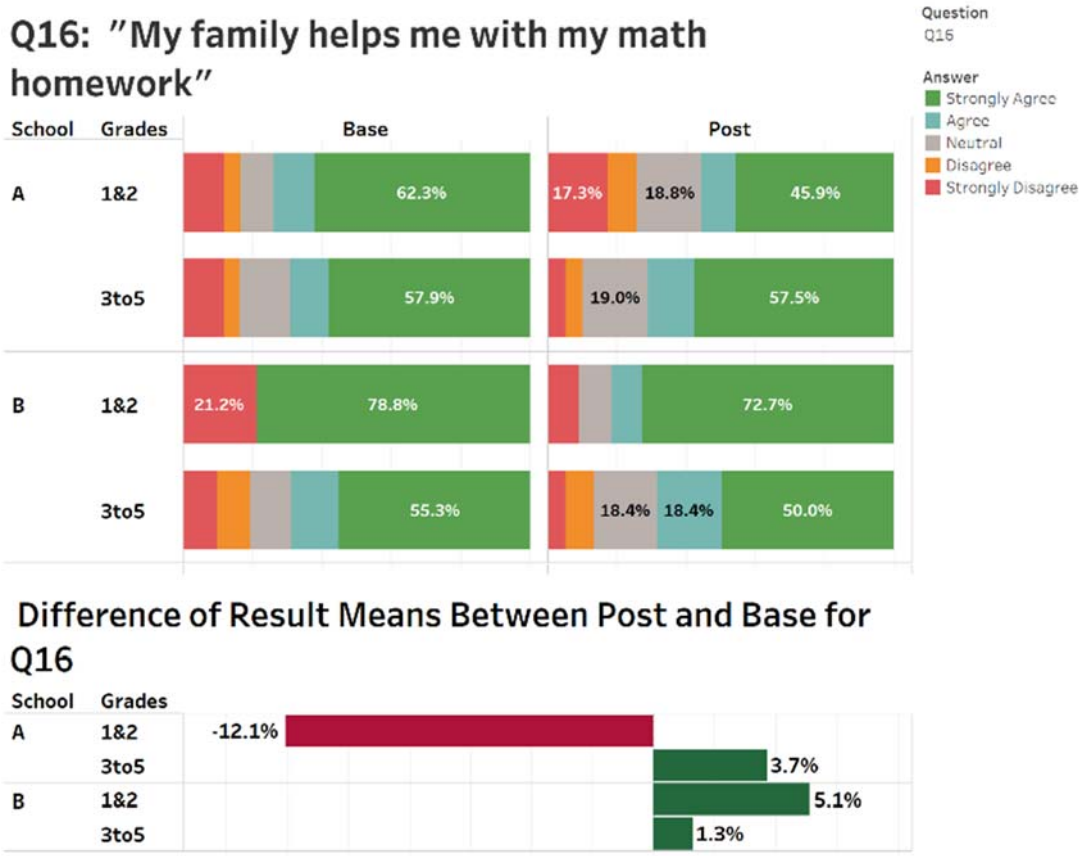




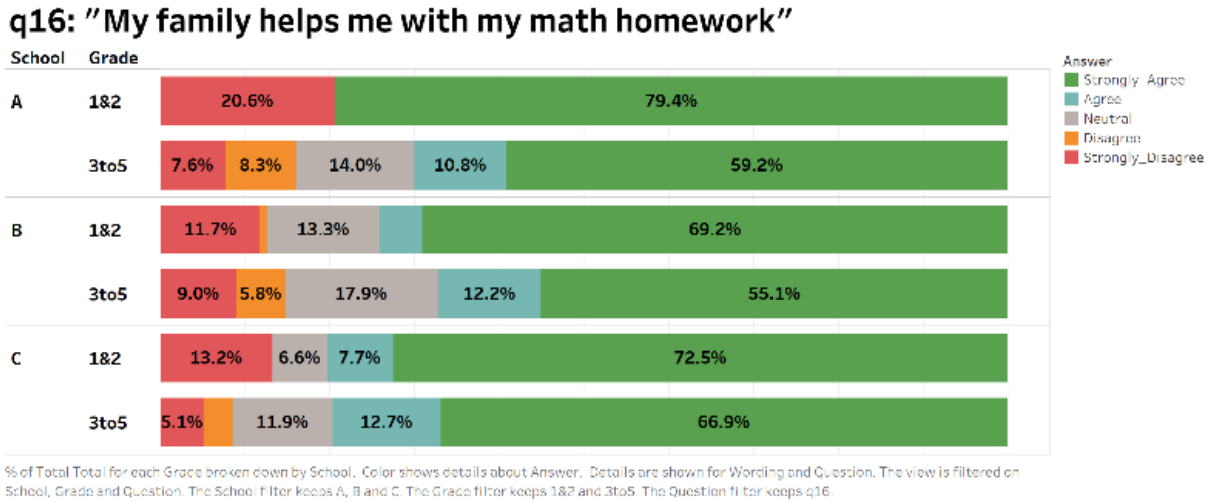
Asking to what degree they agreed with the statement, “The only math I do outside of school is my homework,” a majority of year 2 students in grades 1 & 2 at School A (68.9%) strongly agreed as did 50.0% at School B, and 54.5% at School C. None of the students in grades 3 to 5 at the three schools as reflected by the count at A with 29.3%, 22.5% at B, and 37.3% at C.



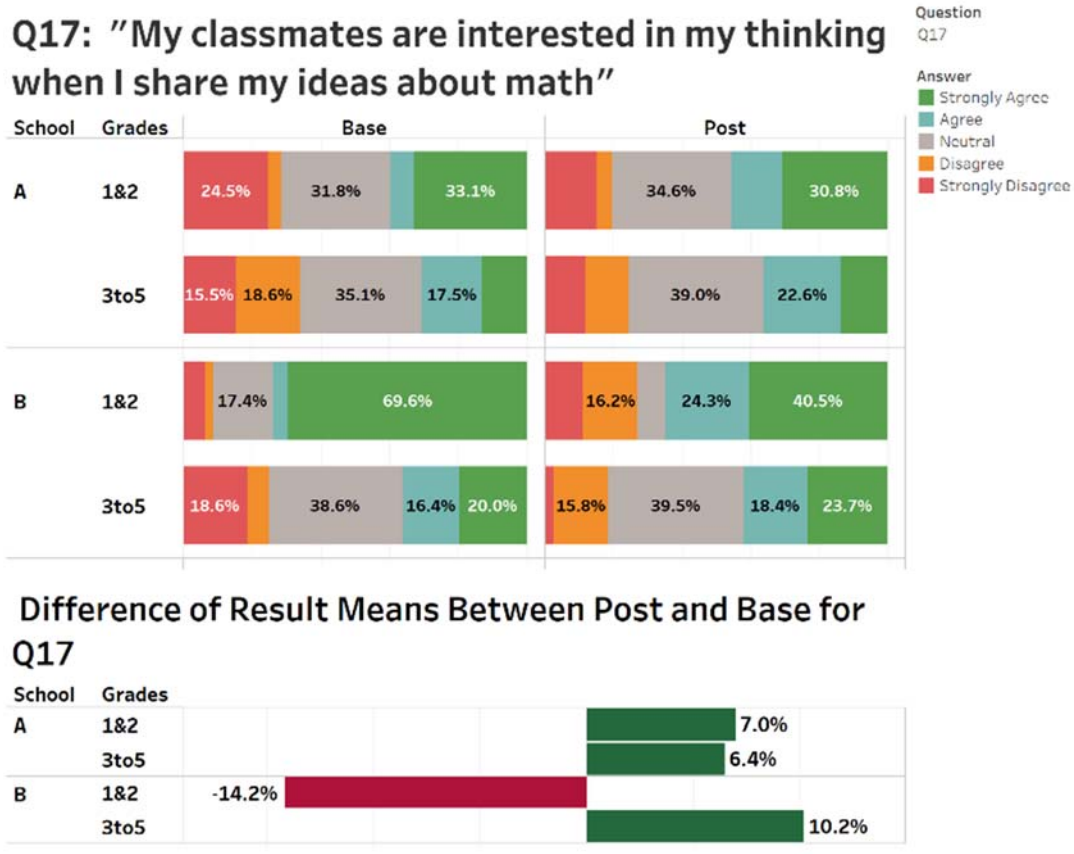
As in query 13 above, the following probed whether students agreed that their family helped with their homework. The difference in results means for this showed a decrease of -12.1% for grades 1 & 2 at School A and an increase of 3.7% for grades 3 to 5. At School B, both grade levels showed gains with a level of 5.1% for grades 1 & 2 and 1.3% for grades 3 to 5.



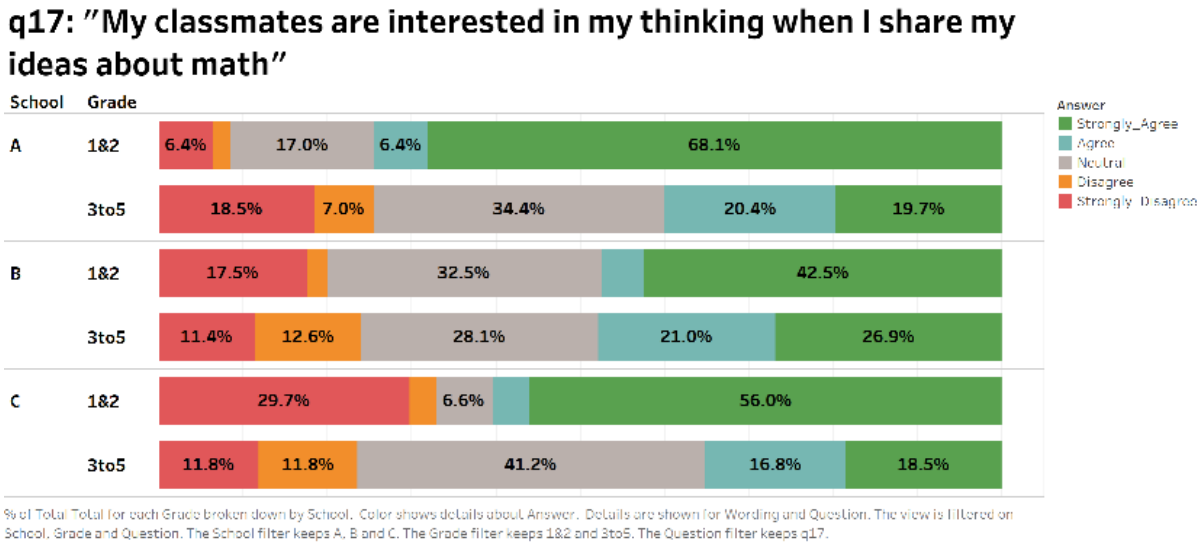
When asked to respond on the level of agreement with this prompt, "My family helps me with my homework," majorities of year 2 students in both grade groups and across all three schools strongly agreed. For grades 1 & 2, School A shows 79.4%, School B at 69.2%, and School C with 72.5% made this choice. In grades 3 to 5, the distribution across the schools is A:59.2%, B:55.1%, and C:66.9%.



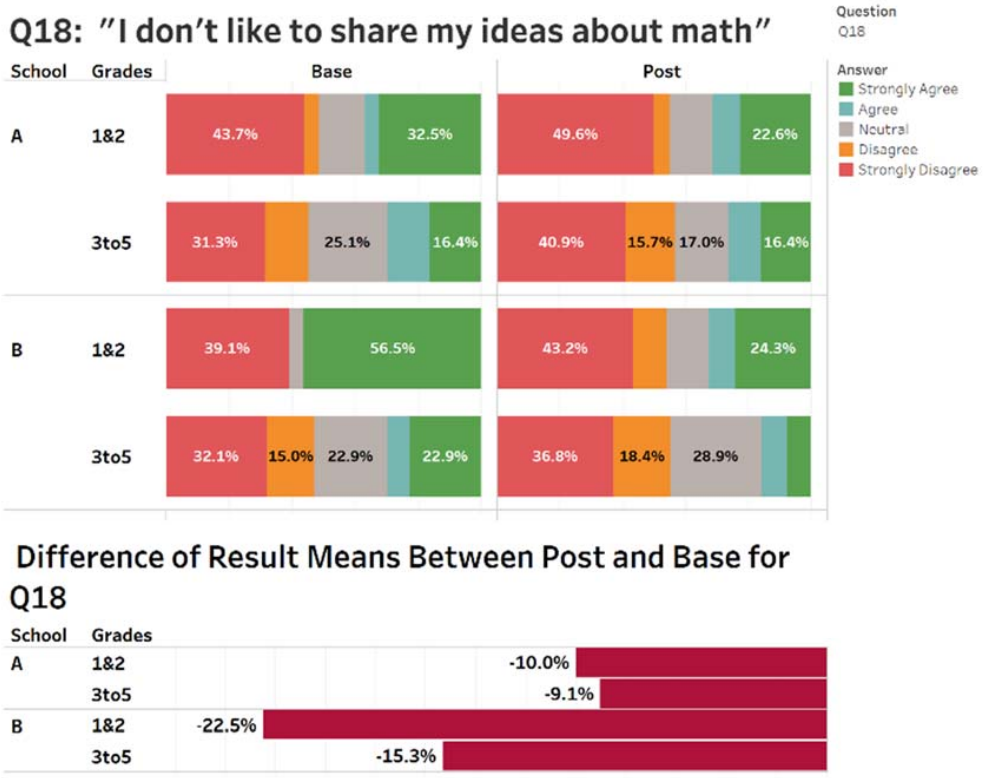
While an earlier query, number 9, looked at whether a student thoughts others could learn something from their ideas about math, the following queried whether they thought other students would be interested in their thinking when they shared ideas about math. The difference in results means at School A for grades 1 & 2 and grades 3 to 5 showed net increases of 7.0% and 6.4%, respectively. At School B, there was a net decrease of -14.2% for grades 1 & 2, and a net increase of 10.2% for grades 3 to 5.



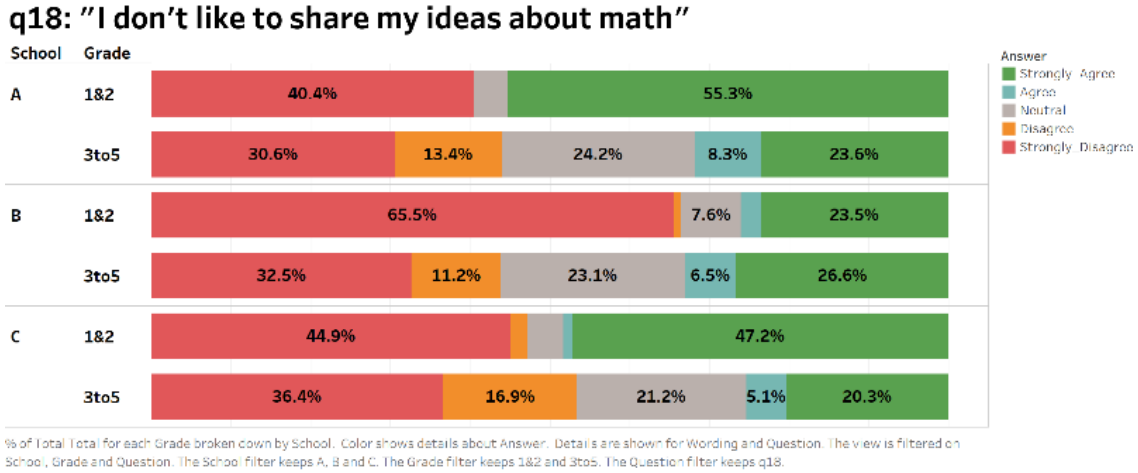
The percentages of year two children who strongly agreed with the statement, "My classmates are interested in my thinking when I share my ideas about math," show a broad distribution. For instance, in grades 1 & 2 at School A the percentage is 68.1, for School B the figure is 42.5%, and 56.0% at School C. At grade levels 3 to 5, the percentages who made that selection dropped to 19.7% at School A, 26.9% at B, and 18.5% at C.



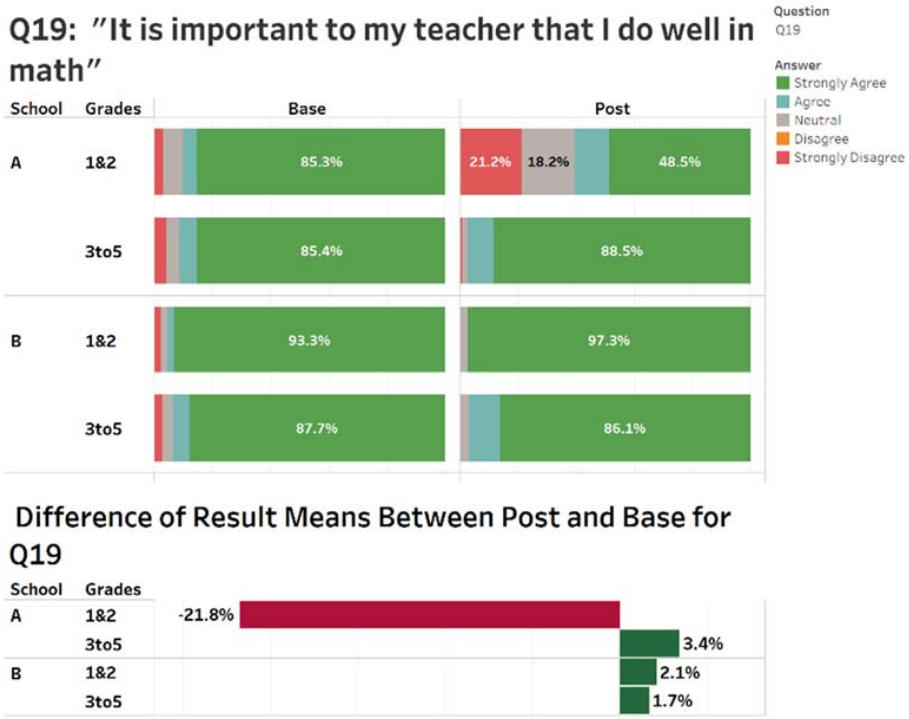
The degree to which students agreed with the statement, "I don't like to share my ideas about math," was the focus of the next prompt. The difference of the result means for responses shows decreases of -10.0% for grades 1 & 2 and -9.1% for grades 3 to 5 at School A. For School B, the declines came in at -22.5% and -15.3% for the two grade groups. An unwillingness to share ideas about math can pose an impediment to effective group work and can lead to isolation and being caught in one's thoughts that may not be productive. Whereas, being willing to share ideas about math can help with "cross pollination" among students and can support germination of ideas about how to solve problems that relying only on the resources individuals possess may slow that process.



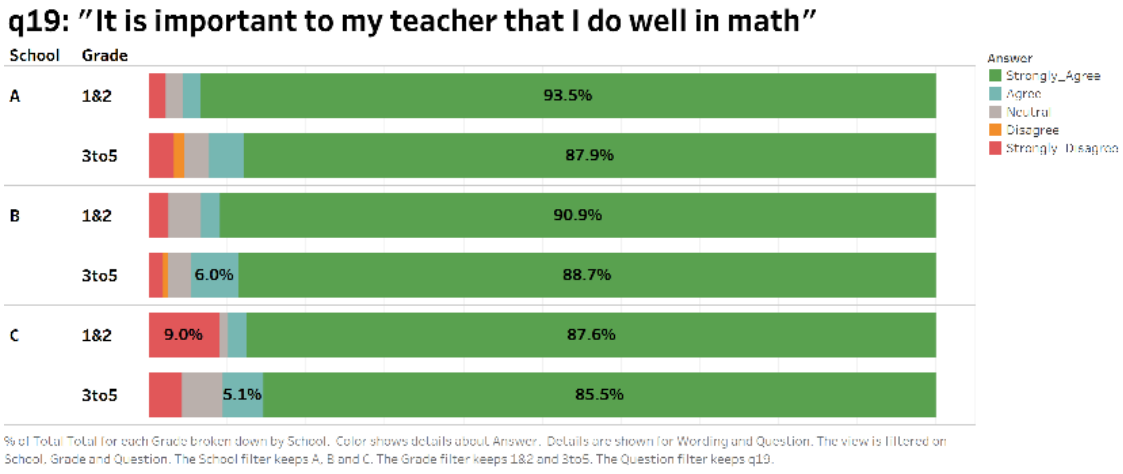
Strongly agreeing with the statement, "I don't like to share my ideas about math," only appeared in a majority of year two students in grades 1 & 2 at School A. At School B, this figure was less than a quarter at 23.5% and at nearly 1/2 at 47.2% for School C. For students at grade levels 3 to 5, the percentages of students who made this choice dropped into the twenties at each school as shown here—A:23.6%; B:26.6%; and C:20.3%.



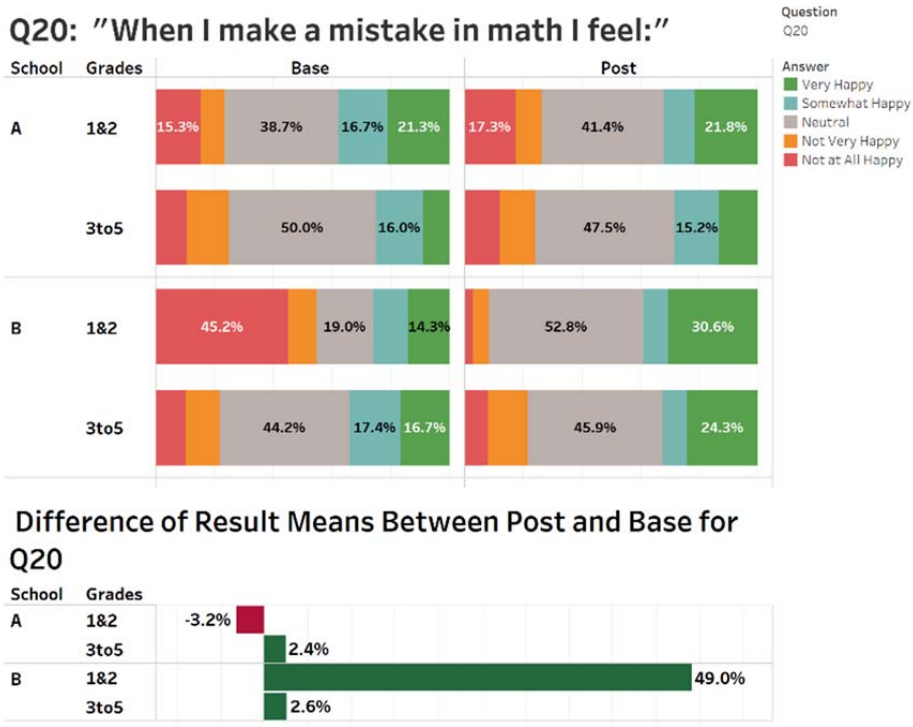
Perceiving that your teacher wants you to do well in your academics can provide an important psychological boost for students. The following query focused on math and the difference of results means showed a decline of -21.8% for grades 1 & 2 and an increase of 3.4% for grades 3 to 5 at School A. For School B, the result means difference showed increases of 2.1% and 1.7% for the two grade levels.



The message that their teacher wants them to well in math is clearly represented in the results to this prompt. Asked to how much they agreed with the statement, "It is important to my teacher that I do well in math," significant majorities of year two students at both grade group levels and across all three schools chose strongly agreed. The percentage counts for grades 1 & 2 came in at 93.5%, 90.9% and 87.6% for schools A, B, and C, respectively. For grades 3 to 5, the counts were A:87.9%, B:88.7%, and C:85.5%

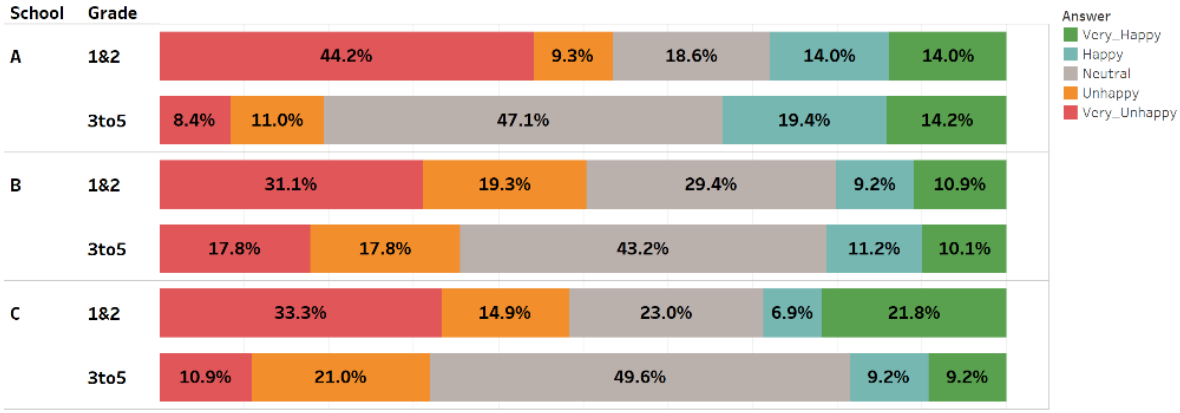


The last question of the survey wanted to know how students felt when they made a mistake in math. Making mistakes in math shows that the student is willing to stretch their thinking and experiment with different approaches to problem solving. So, they should not feel bad when they do make a mistake. For this query the difference in result means at School A show a decline of -3.2% in grades 1 & 2 and an increase of 2.4% for grades 3 to 5. At School B, there was an increase of 49% in grades 1 & 2 and 2.6% for grades 3 to 5.



Too much emphasis on getting the right answer can lead to anxious and unhappy minds. By recognizing that it is alright to make mistakes and recognizing that doing so is a way to grow intellectually and develop skills and can help build mental resilience and persistence, key elements in developing a growth mindset and both Dweck and Boaler establish in their research. The scale on this prompt was different from the others in that it sought to measure the level of happiness rather than agreement. While the year 2 younger children in grades 1 & 2 at each school showed more likelihood of being very unhappy with percentages of 44.2% at A, 31.1% at B, and 33.3% at C. However, as they age up, the percentages in grades 3 to 5 decline to 8.4%, 17.8%, and 10.9%, in Schools A, B, and C, respectively. Worth noting is that at the higher grade group, those students who chose the neutral response came in at 47.1%, 43.2% and 49.6% for the three school A, B, and C, in turn.

q20: "When I make a mistake in math I feel:"



% of Total Total for each Grade broken down by School. Color shows details about Answer. Details are shown for Wording and Question. The view is filtered on School, Grade and Question. The School filter keeps A, B and C. The Grade filter keeps 1&2 and 3to5. The Question filter keeps q20.

PARCC Analysis

The following provides summary information for population subgroup performance in math gathered from the PARCC data for Schools A and B that participated in the FACESS study. In order to protect the identity of any students in a subgroup with an N of < 10, those groups have been excluded from the analyses results and are indicated by an asterisk (*) in the various tables. The first table provides the breakdown by subgroup for each school. As noted at the bottom of Table A, 887 student cases are used in these analyses.

Tables B, C, and D, below show disparities in PARCC scaled scores, performance levels, and passing rates. To achieve this, we used the 2017-18 data set as the base to show scores prior to intervention (i.e. FACESS professional development, etc.) then calculated the difference in scores for each subgroup for each school and each year. We then subtracted the scores for one subgroup from the other, (as an example, African American students from White Students) and subtracted the earlier difference from the newest difference. The results shown in the summary section at the bottom of each table illustrate that where positive figures appear, the gap between groups increased and where negative the gap decreased. The term “disparities” simply describes the differences between groups.

The essential finding we want to reveal is whether the mean differences between any two groups are the same in both years. To make this determination, we applied two rounds of t-tests. We first ran t-tests between comparison groups in both years, then used information generated from these t-tests in an additional “immediate” t-test. This meant supplying for year 1 and year 2 the combined number of observations in the two groups, the calculated mean difference generated between the two groups, and the standard error for this difference. Finally, we assessed these calculations to determine the statistical significance of whether the difference between mean differences was not equivalent to zero. We designate the levels of statistical significance in the following tables, B, C, and D, by the following: * = $p<.05$, ** = $p<.01$, *** = $p<.001$.

Table A. Subgroup sample sizes with PARCC data by school and year

Race/ethnicity	Pre-Intervention/Base 2017-18		Post-Intervention 2018-19	
	School A	School B	School A	School B
African-American	12	+	16	11
Asian	+	+	+	+
Hispanic	87	190	86	174
Native American	+	11	+	13
Pacific Islander	+		+	
Two or More	23	+	19	+
White	94	+	81	13

ELL	2017-18		2018-19	
	School A	School B	School A	School B
N	205	86	192	99
Y	26	138	23	118

Free/Reduced Lunch	2017-18		2018-19	
	School A	School B	School A	School B
C			47	213
F	66	165	44	+
N	122	57	91	+
R	43	+	33	

Special Ed (not gifted)	2017-18		2018-19	
	School A	School B	School A	School B
N	184	151	169	144
Y	47	73	46	73

Total students in sample with PARCC data: 887

Notes: The order of PARCC performance levels and the calculation of the binary PARCC pass variable (pass = 1 if performance level = 4 or 5) comes from page 2 of https://www.isbe.net/Documents/parcc-spring-16-score-interpretation-guide.pdf

Cell sizes <=10 are hidden with a + sign to protect student privacy

Table B below shows the difference in scaled mean PARCC scores between subgroups at School A and School B between school years 2017-18 and 2018-19. The primary calculation is between whites and other subgroups. Key findings that appear in the summary table below show that achievement gaps grew for each of the reported subgroups (African American, Hispanic, and 2 or More) and whites by 3.75, 6.16, and 4.31, respectively at School A. The difference between Native Americans and Hispanics for the two points in time showed a decrease of nearly 13 points at School B. For English Language Learners (ELL) the difference was 3.45 at School A and decreased by -4.89 for School B. Changes for FRL Students (F & N) came in as a decrease of -2.56 for F & N and an increase of 11.85 for R & N at School A. The disparity figures for SpEd students decreased for both schools are shown by the figures of -7.86 at School A and -3.27 at School B.

Table B: Measuring achievement gaps: Differences in scaled mean PARCC scores

Race/ethnicity	Pre-Intervention/Base 2017-18		Post-Intervention 2018-19	
	School A	School B	School A	School B
African-American	735.6	+	726.4	706.2
Asian	+	+	+	+
Hispanic	732.1	699.9	720.5	707.4
Native American	+	696.9	+	717.2
Pacific Islander	+		+	
Two or More	744.1	+	734.4	+
White	748.6	+	743.2	725.6

ELL	2017-18		2018-19	
	School A	School B	School A	School B
N	744.1	710.8	734.7	715.4
Y	722.0	694.4	709.2	703.9

Free/Reduced Lunch	2017-18		2018-19	
	School A	School B	School A	School B
C			728.2	709.4
F	723.2	696.6	718.3	+
N	750.3	712.5	742.8	+
R	745.2	+	725.8	

Special Ed (not gifted)	2017-18		2018-19	
	School A	School B	School A	School B
N	751.6	712.2	740.8	719.9
Y	702.4	676.9	699.5	687.9

	School A	School B
Change in disparities between White and African-American	3.75**	+
Change in disparities between White and Hispanic	6.16***	+
Change in disparities between White and Two or More	4.31***	+

Change in disparities between Hispanic and Native American	+	**-12.79*** **

	School A	School B
Change in disparities between ELL Y/N	3.45***	**-4.89*** **

	School A	School B
Change in disparities between F & N	**-2.56*** **	+
Change in disparities between R & N	11.85***	

	School A	School B
Change in disparities between SpEd Y/N	**-7.86*** **	**-3.27*** **

Table C below shows an alternative analyses by illustrating differences in mean PARCC performance levels of 1-5. As above, the primary calculation is between whites and other subgroups. Key findings that appear in the summary table below show that the mean PARCC performance level gaps grew for each of the reported subgroups (African American, Hispanic, and 2 or More) and whites by 0.14, 0.22, and 0.24, respectively at School A. The difference between Native Americans and Hispanics for the two points in time showed a decrease of -0.61 points at School B. For English Language Learners (ELL) the difference was 0.19 at School A and decreased by -0.14 for School B. Changes for FRL Students came in as a decrease of -0.07 for F & N and an increase of 0.40 for R & N at School A. The disparity figures for SpEd students decreased for both schools are shown by the figures of -0.15 at School A and -0.04 at School B.

Table C: Measuring achievement gaps: Differences in mean PARCC performance levels

Race/ethnicity	Pre-Intervention/Base 2017-18		Post-Intervention 2018-19	
	School A	School B	School A	School B
African-American	2.83	+	2.56	1.91
Asian	+	+	+	+
Hispanic	2.77	1.75	2.42	1.94
Native American	+	1.36	+	2.15
Pacific Islander	+		+	
Two or More	3.22	+	2.84	+
White	3.31	+	3.17	2.46

ELL	2017-18		2018-19	
	School A	School B	School A	School B
N	3.16	2.09	2.89	2.19
Y	2.46	1.59	2.00	1.82

Free/Reduced Lunch	2017-18		2018-19	
	School A	School B	School A	School B
C			2.55	2.00
F	2.45	1.64	2.34	+
N	3.38	2.18	3.20	+
R	3.19	+	2.61	

Special Ed (not gifted)	2017-18		2018-19	
	School A	School B	School A	School B
N	3.40	2.09	3.10	2.30
Y	1.81	1.14	1.65	1.38

	School A	School B
Change in disparities between White and African-American	0.14**	+
Change in disparities between White and Hispanic	0.22***	+
Change in disparities between White and Two or More	0.24***	+
Change in disparities between Hispanic and Native American	+	**-0.61*** **

	School A	School B
Change in disparities between ELL Y/N	0.19***	**-0.14*** **

	School A	School B
Change in disparities between F & N	**-0.07** **	+
Change in disparities between R & N	0.40***	

	School A	School B
Change in disparities between SpEd Y/N	**-0.15*** **	**-0.04*** **

Table D below shows the differences in mean PARCC passing rates for performance levels between 1-3 to 4-5. Here too, the primary calculation is between whites and other subgroups. Key findings that appear in the summary table below show that the differences in mean PARCC passing rates grew for each of the reported subgroups (African American, Hispanic, and 2 or More) and whites by 0.13, 0.05, and 0.11, respectively at School A. The difference between Native Americans and Hispanics for the two points in time showed a decrease of -0.07 points at School B. For English Language Learners (ELL) the difference was a decrease of -0.07 at School A and -0.04 at School B. Changes for FRL Students came in as a decrease of -0.11 for F & N and an increase of 0.23 for R & N at School A. The disparity figures for SpEd students decreased by -0.17 for School A and increased by 0.02 at School B.

Table D. Measuring achievement gaps: Differences in mean PARCC passing rates

Race/ethnicity	Pre-Intervention/Base 2017-18		Post-Intervention 2018-19	
	School A	School B	School A	School B
African-American	0.42	+	0.19	0.09
Asian	+	+	+	+
Hispanic	0.34	0.06	0.20	0.06
Native American	+	0.00	+	0.08
Pacific Islander	+		+	
Two or More	0.52	+	0.32	+
White	0.54	+	0.44	0.23

ELL	2017-18		2018-19	
	School A	School B	School A	School B
N	0.50	0.15	0.33	0.13
Y	0.23	0.01	0.13	0.03

Free/Reduced Lunch	2017-18		2018-19	
	School A	School B	School A	School B
C			0.28	0.08
F	0.26	0.04	0.23	+
N	0.58	0.16	0.44	+
R	0.47	+	0.09	

Special Ed (not gifted)	2017-18		2018-19	
	School A	School B	School A	School B
N	0.57	0.10	0.38	0.12
Y	0.06	0.00	0.04	0.00

	School A	School B
Change in disparities between White and African-American	0.13***	+
Change in disparities between White and Hispanic	0.05***	+
Change in disparities between White and Two or More	0.11***	+

Change in disparities between Hispanic and Native American	+	**-0.07*** **

	School A	School B
Change in disparities between ELL Y/N	**-0.07*** **	**-0.04*** **

	School A	School B
Change in disparities between F & N	**-0.11*** **	+
Change in disparities between R & N	0.23***	

	School A	School B
Change in disparities between SpEd Y/N	**-0.17*** **	0.02***

References

Boaler, J. (2016), *Mathematical Mindset: Unleashing students' potential through creative math, inspiring messages and innovative teaching.* Jossey-Bass.

Carpenter, T. P., Fennema, E. A., Franke, M. L. (1996). Cognitively Guided Instruction: A knowledge base for reform in primary mathematics instruction. *The Elementary School Journal* 97:1 pp. 3-20. DOI: 10.1086/461846.

Carpenter, T.P., Fennema, E., Loef Franke, M., Levi, L., and Empson, S.B. (2014). *Children's Mathematics: Cognitively Guided Instruction.* (2nd Edition). Portsmouth, NH: Heinemann.

Dweck, C.S. (2006). *Mindset: The new psychology of success.* Ballantine Books.

Ghousseini, H. (2017). Rehearsals of Teaching and Opportunities to Learn Mathematical Knowledge for Teaching, *Cognition and Instruction,* 35:3, 188-211, DOI:10.1080/07370008.2017.1323903

Hintz, A., Tyson, K. (2015). Complex Listening: Supporting Students to Listen As Mathematical Sense-makers. *Mathematical Thinking and Learning.* 17. 296-326. 10.1080/10986065.2015.1084850.

Hufferd-Ackles, K., Fuson, K., Sherin, M. (2004). Describing Levels and Components of a Math-Talk Learning Community. *Journal for Research in Mathematics Education.* 35. 81. DOI: 10.2307/30034933.

Kazemi, E. and Hintz, A. (2014). *Intentional Talk: How to Structure and Lead Productive Mathematical Discussions.* Portsmouth, NH: Stenhouse Publisher.

Poulas, J.A. (2001). *Innumeracy: Mathematical illiteracy and its consequences*. NY: Hill and Wang.

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